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MODERN PLASTICS

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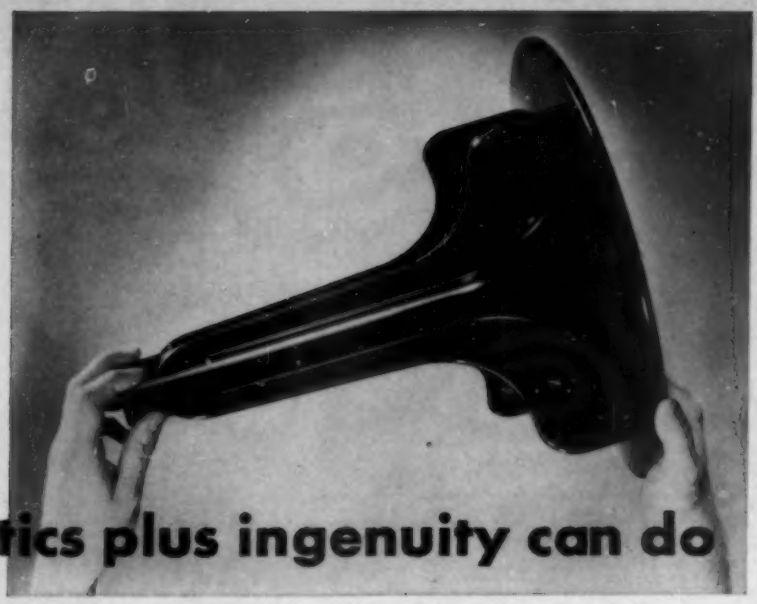
AUGUST 1945



Look what plastics plus ingenuity can do

Unsung hero of plastics progress is the custom molder. Through his untiring efforts and remarkable ingenuity, the use of plastics has become extensive in practically all fields of industry. Typical of the thousands of items which have been developed or improved through the intelligent application of plastics, is this Durez phenolic plastic washing machine agitator molded by Eclipse Moulded Products Co.

Reports from users of this molded Durez washing machine agitator attest a definite superiority over those made from other materials. The surface, for example, is permanently clean, smooth and lustrous from the moment it leaves the mold. Furthermore, it is inert to washing solutions and its action on clothes is easy and gentle. Tests which ran as long as 2400 hours continuously proved this agitator to be thoroughly satisfactory in every respect.

Answering A Need

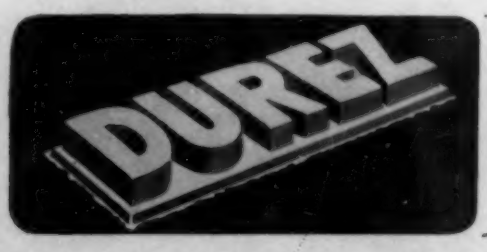
As long as twenty years ago, washing machine manufacturers were searching for a plastic material that could be used in producing an agitator — the only part of the washer that remained the same year after year. The engineers turned to plastics — then in the adolescent stage — because they wanted an agitator that would increase the speed of the washing action while retaining a smooth, glossy surface that would be easy and gentle on clothes.

The Eclipse Moulded Products Company helped pioneer this search, and the molded Durez phenolic plastic agitator illustrated is the evidence of their persistence, ingenuity, and resultant success. Like so many of America's custom molders, they became aware of a need in industry and answered it completely.

Versatile Plastic Used

Needless to say, the plastic used in molding this agitator had to be versatile, and the choice of the proper material was naturally most difficult. A Durez phenolic plastic was selected for two reasons. First, the phenolics, in themselves, are the most versatile of plastics. Second, Durez has specialized in the production of the phenolics for over a quarter century and has a line of more than 300 molding compounds from which to select the plastic that precisely fits the job.

In this case, the emphasis was on moisture resistance, alkali resistance, excellent moldability, and impact strength. In another case, it might well be on dielectric strength, arc-resistance and non-bleeding. In all cases, the versatility of Durez phenolics is the natural starting point when you're struggling for the solution of a plastic material problem. The services of experienced Durez technicians, plus a wealth of proved product development data, are available at all times to you and your custom molder. Durez Plastics & Chemicals, Inc., 268 Walck Road, North Tonawanda, N. Y.



PHENOLIC RESINS

- MOLDING COMPOUNDS
- INDUSTRIAL RESINS
- OIL SOLUBLE RESINS

PLASTICS THAT FIT THE JOB

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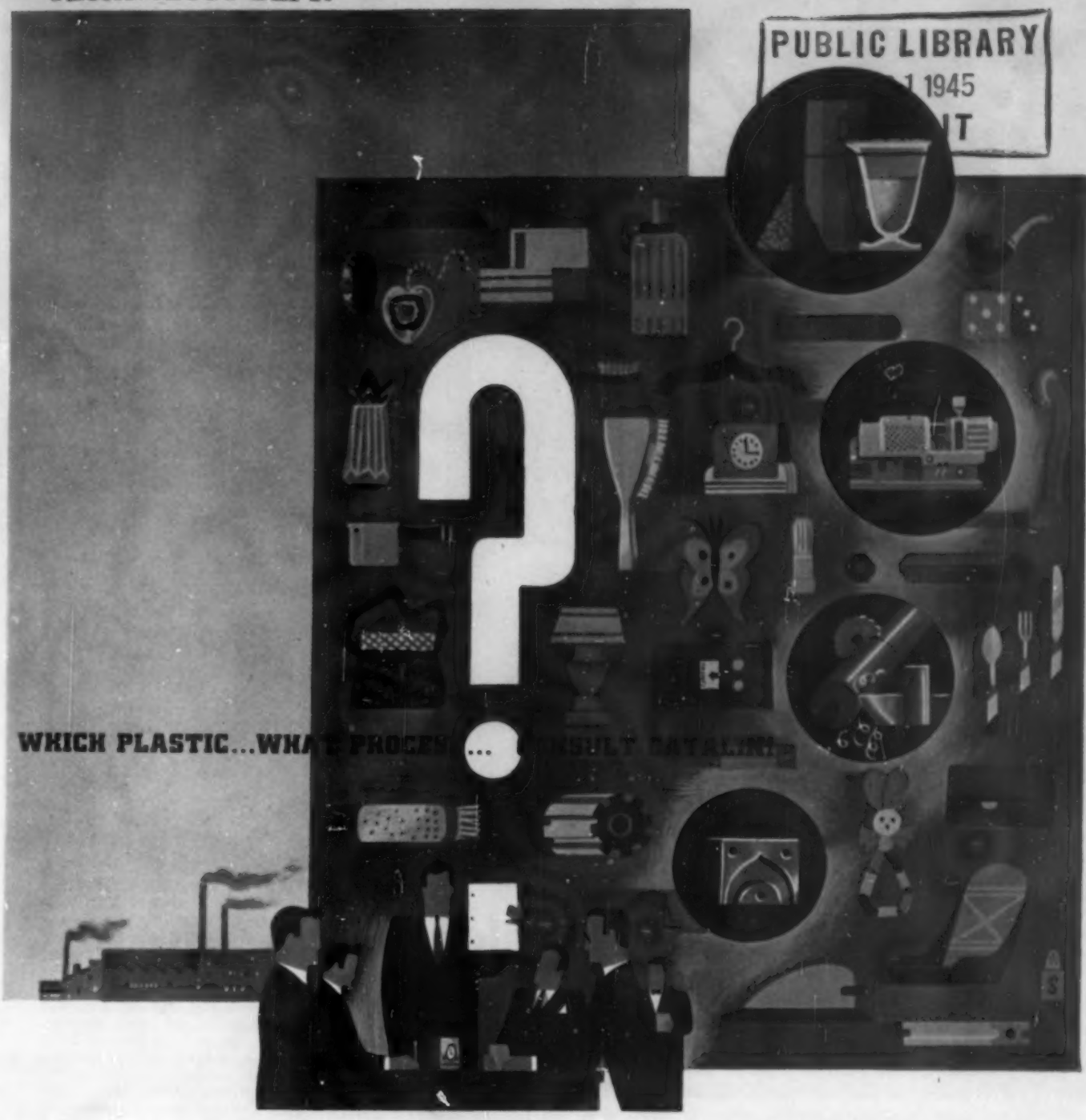

In the projection of a plastic product, part or application, the selection of the right material and the proper method of processing it can gain much from a before-hand meeting of minds.

We, of Catalin, as a raw materials producer, would welcome any opportunity to sit in with product designers or manufacturers when their pencils are busy. Equally, would we like to be at a round-table with those in the plastics field itself when problems bear upon the choice of the most adaptable plastics material.

In the light of our experience and as representatives of a family of notable plastics, we feel that our suggestions will fit in with your ideas and prove helpfully advantageous.

Desirous to serve, the members of Catalin's technical staff are readied now to direct their plastics know-how to your problems and plans. Inquiries cordially invited!

CATALIN CORPORATION

ONE PARK AVENUE, NEW YORK 16, N. Y.

CAST RESINS · LIQUID RESINS · MOLDING COMPOUNDS

Modern Plastics

AND PLASTICS

★ ★ ★

AUGUST 1945

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Water-borne polyvinyl resins provide safer, simpler coating methods

GEON latex is a film-forming plastic material used to apply thin coatings to fabric, paper, fibre, thread, wire or any other material to which coatings can be applied by conventional methods. It is a true latex—a water dispersion containing a solid content of approximately 50% vinyl resin. Especially suitable for use in continuous processes, GEON latex is an easy-flowing, milk-like liquid of remarkably high stability. It is *not* rubber and contains *no* rubber

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GEON latex, like all latices, has its limitations. It is not a "miracle material", that will do away with other coating methods. Yet already its use in military and related applications has proved that entire new fields in coatings will be opened up by this new material, the development of which was a true scientific achievement. For more information, write Department II-8, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

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B. F. Goodrich Chemical Company

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Protects the *Mariner's* "Lungs"!

On the underside of each of the Martin "Mariner's" twin motors is an oil cooler panel that sucks in the air which cools the oil system. The leading edge of this assembly is molded for the Glenn L. Martin Company by Richardson. Molded INSUROK is used because it prevents kinks in the nose, protects it from excessive wear and tear, and thus reduces maintenance and replacement. In addition, INSUROK saves tank welding on sheet metal parts, and simplifies assembling operations.

The Glenn L. Martin Company's experience is typical of how Molded INSUROK —properly used—can serve industry efficiently and economically. Let Richardson Plasticians show you what INSUROK —Molded and Laminated—can do for you. Write today for full information.

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CLEVELAND OFFICE: 326-7 PLYMOUTH BLDG., CLEVELAND 15, OHIO

THIS after-war period is going to be a new age, not just a resumption of what we were doing before the war. You can't drag out old molds, forms and dies and start in where you left off around Pearl Harbor time.

No material has made the strides that plastics have made in new wartime applications.

No company has shown more of the pioneering spirit than Erie Resistor in exploring new methods, new applications, new combinations of essential characteristics.

Tell us what your product must have in mechanical strength, temperature range, electric insulation, delicacy and permanence of color . . . if there's a solution in terms of plastics, Erie Resistor can give you the answer.

First in the field of Custom Injection Molding, and first in some other developments whose revelation will have to wait on V-J Day, we might, given the opportunity, be the first to show you the way to cheaper production, or a better product with greater sales appeal, or both.

Let's get our heads together on a more practical grip for that portable electric tool—a case that's cheaper to make and faster to sell for that new alarm clock—a toilet set that will make milady's dressing table rival Marie Antoinette's.

For plastics compounded with brains and molded with art, call on Erie Resistor.

BUY EXTRA WAR BONDS

Plastics Division

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FOR HIGH ACHIEVEMENT IN WAR PRODUCTION

BOBBINS for BRITAIN . . .

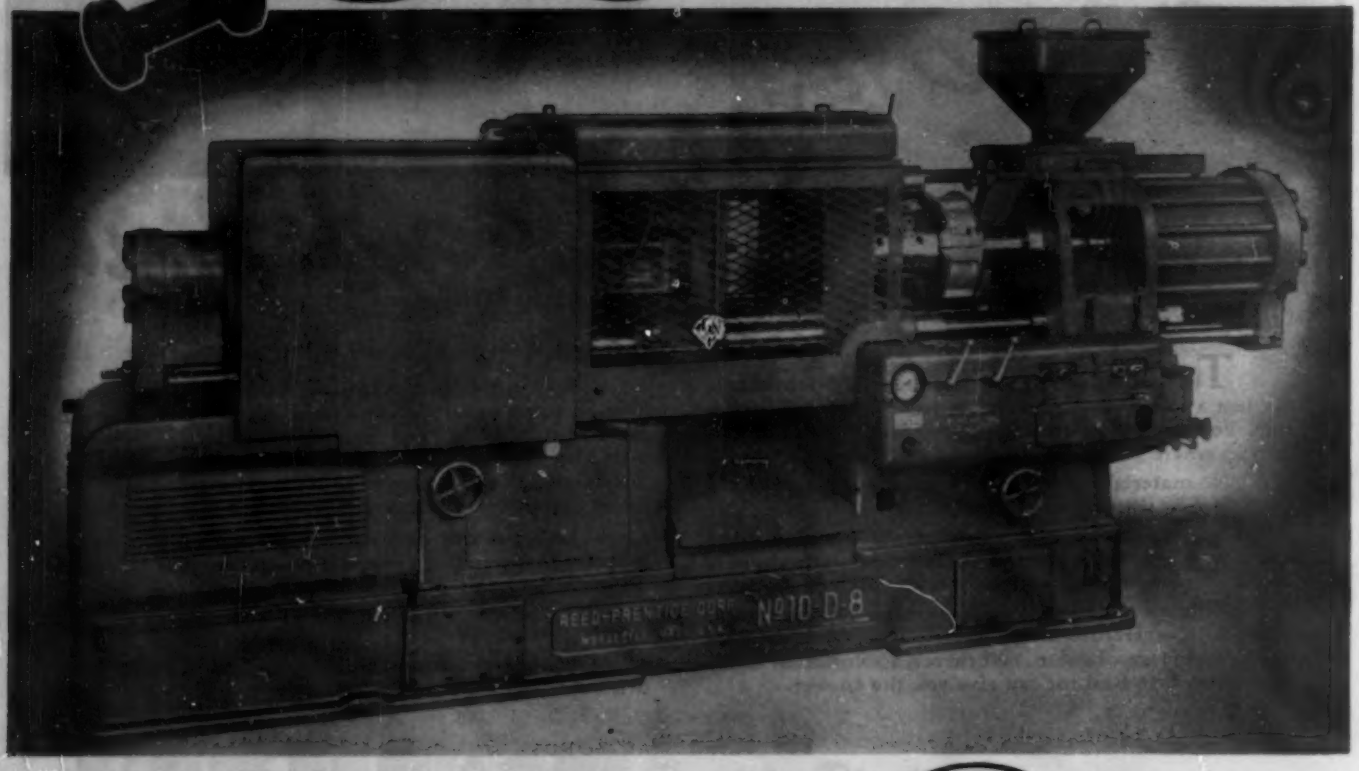
Speeding Britain's essential war-time production is just as much a part of Reed-Prentice plastic injection moulding machine performance as in the United States.

Alfred Herbert Ltd. (Reed-Prentice representatives in England) sends these photographs of the 10D-6 oz. machine in action at the plant of British Insulated Cables, Ltd. Prescott — with the following remarks —

". . . these (plastic) bobbins are made in two halves and cemented together afterwards. They are used for winding fine copper wire, and have been found greatly superior to the wooden bobbins previously supplied for this purpose as they are unbreakable, and are supplied to the customers on a returnable basis."

If you want to know more about molds or the molding process for thermoplastics, the builders of the largest selling line of injection molding machines in America invite you to submit your problems. Make your plans *today* worth dollars tomorrow!

MACHINES AVAILABLE IN 22, 16, 12, 8 and 6 Oz. SIZES.



Reed-Prentice 10D-8 Oz. plastic injection Molding Machine.

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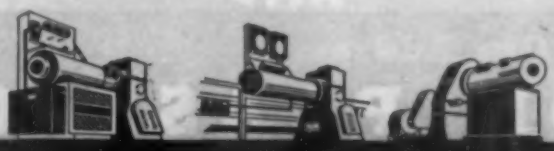
Thermoplastic material is carried by belt under infra-red dryers and into the 2½-inch National extruder. On being extruded, plastic tube is water cooled and automatically wound into a continuous coil. Operator cuts coil into uniform lengths.

...they get *fast*, *flexible* *economical* production from National Extruders

THE colorful, durable toys made by Wilson Products Co., from coils extruded by Carter Products Corp. of Cleveland, are typical of the infinite variety of shapes for many different kinds of products which can be produced with National extruders.

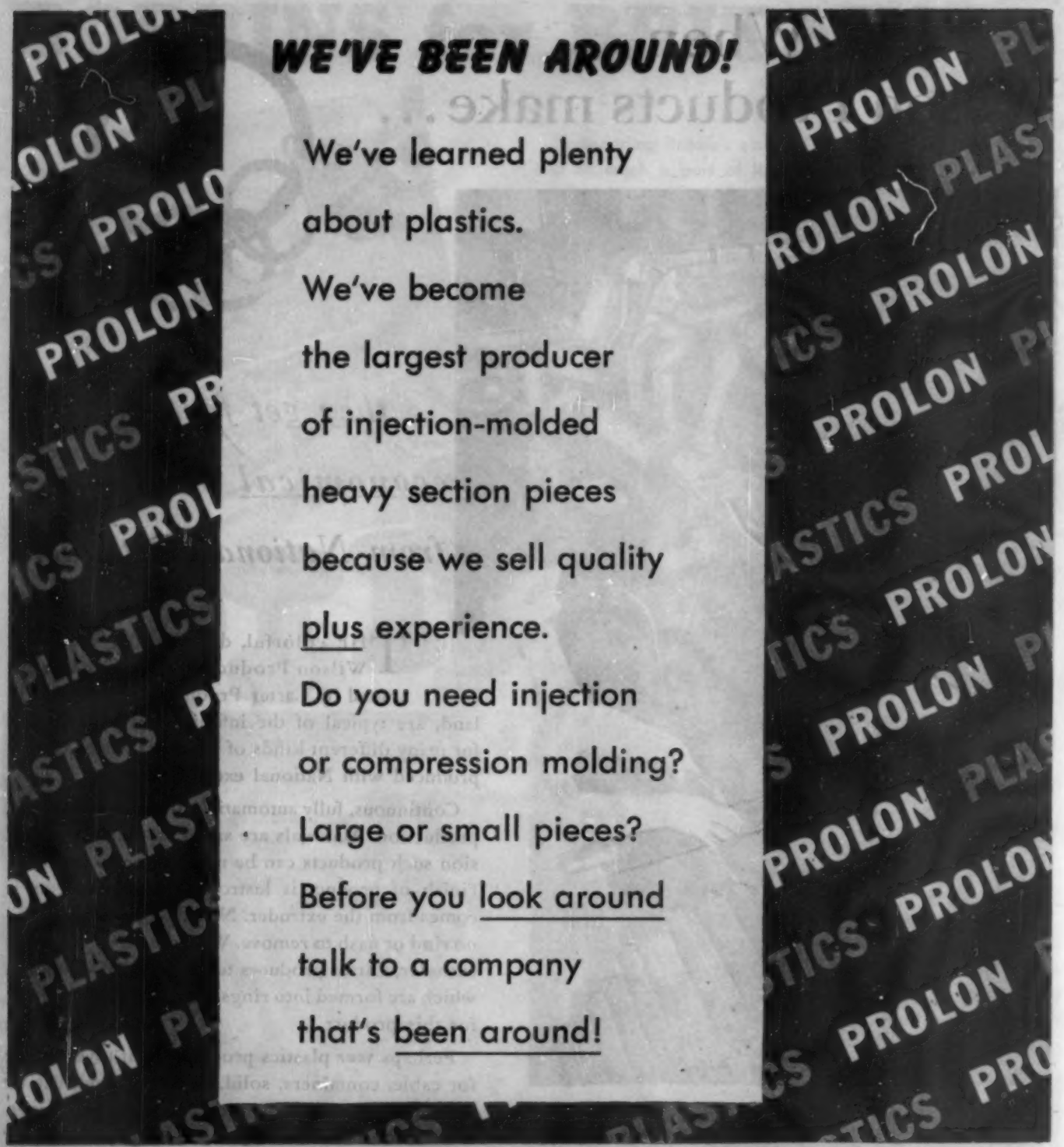
Continuous, fully automatic action assures speedy production. Materials are saved, because by extrusion such products can be made of hollow tubing. Finish of product is lustrous, smooth—just as it comes from the extruder. No buffing necessary . . . no rind or flash to remove. With their 2½" National extruder, Carter produces tubes ⅛" to ½" diameter, which are formed into rings from ¾" to 6" diameter for this product.

Perhaps *your* plastics product—be it toys, tubing for cable, containers, solid, hollow, round, flat, or angular object—can be made *better, cheaper, faster, easier* with a National extruder. Why not find out? Send a brief description of your product requirements to America's largest maker of plastics extrusion machinery, and we'll tell you if there's a possibility of getting *better production* by extrusion methods.



NATIONAL RUBBER MACHINERY CO.
General Offices: Akron 11, O.

Plastics
MACHINERY DIVISION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We've learned plenty
about plastics.
We've become
the largest producer
of injection-molded
heavy section pieces
because we sell quality
plus experience.
Do you need injection
or compression molding?
Large or small pieces?
Before you look around
talk to a company
that's been around!
HAVE YOU A PLASTICS PROBLEM?
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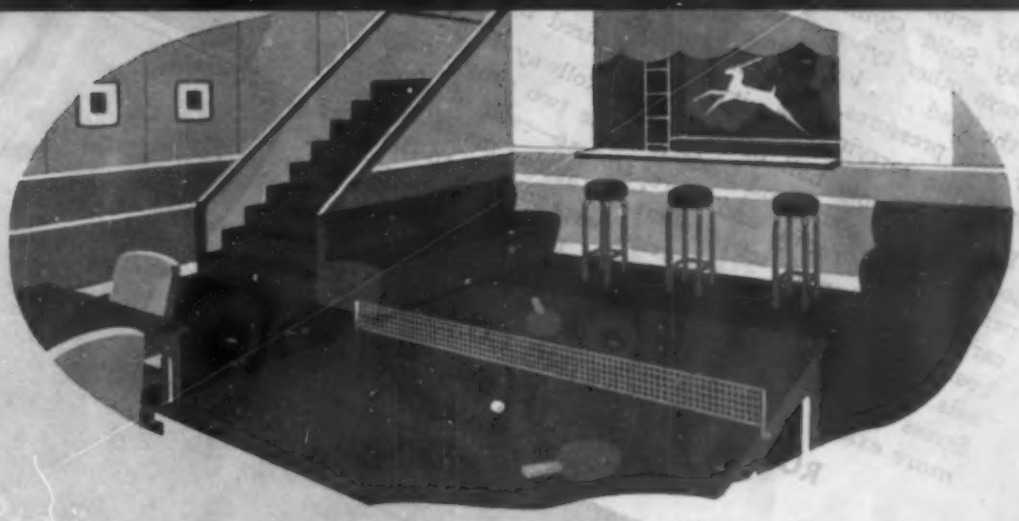
Whether you design Bomb Boxes or Game Rooms . . .



.....your product can be improved with a Kimpreg* Surface

A revolutionary new alloy-like material is achieved by fusing to plywood's surface a cured plastic skin of KIMPREG. This resultant material is not a plywood in the ordinary sense, not a conventional plastic laminate. It is a brand new, better structural medium with countless applications in many products—including, very probably, those *you* plan for post-war production.

With KIMPREG, plywood is converted into an improved substance which can be machined, formed and fastened like ordinary wood—yet has a plastic's smooth, tough surface and beautiful, permanent, paintless finish.

KIMPREG adds the following advantages to plywood: 1) increases durability and flexural strength; 2) provides resistance to moisture and vapor; 3) armor-plates against extreme abrasion; 4) diminishes grain-raising effects; 5) makes the material scuffproof, splinterproof, snag-resistant; 6) affords a stainproof, washable, "wipe clean" surface; 7) creates resistance to chemical action, decay, temperature-extremes, fire, vermin, and mold. Moreover, it is warm to the touch, does not have the chill "feel" of metal surfaces.

Today all KIMPREG is required for military needs, ranging from airborne "prefab" huts to glass-smooth tables for packing parachutes without snagging. Hence, the wartime color of KIMPREG is a soldierly olive-drab. Post-war, however, it will be offered in a variety of appealing hues.

Now is the time to investigate the possibilities of KIMPREG-surfaced materials for your *peacetime* requirements.

*TRADE MARK

Kimpreg TRADE MARK

A PRODUCT OF Kimberly Clark RESEARCH

Among the users of KIMPREG are: Buffalo Lumber & Manufacturing Company; Olympic Plywood Company; Washington Veneer Company; and The Wheeler, Osgood Company; all of whom are currently producing a Douglas Fir Plywood surfaced with KIMPREG. This product is sold under the trade name of Indurok.

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Syracuse, N. Y.

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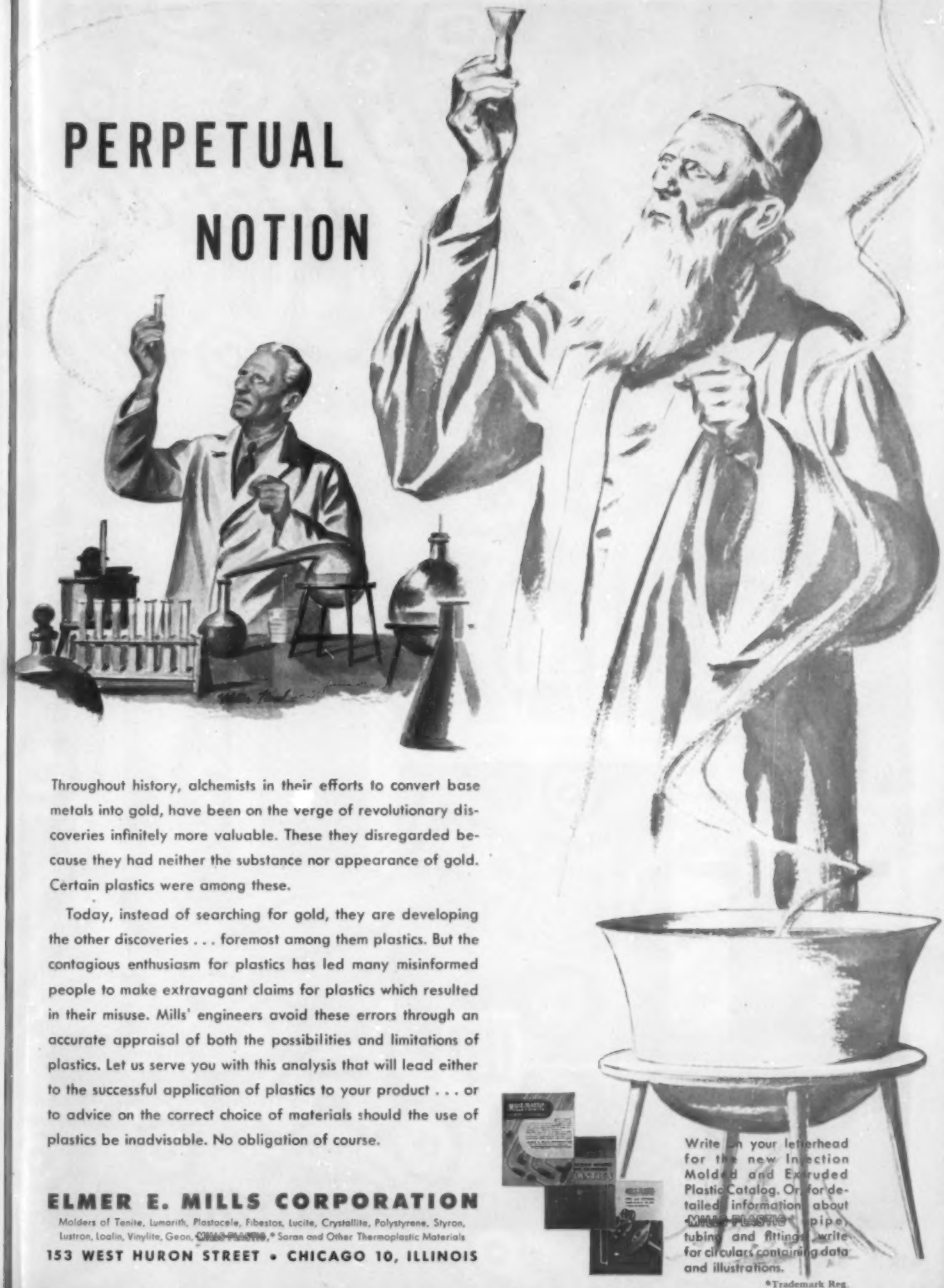

Throughout history, alchemists in their efforts to convert base metals into gold, have been on the verge of revolutionary discoveries infinitely more valuable. These they disregarded because they had neither the substance nor appearance of gold. Certain plastics were among these.

Today, instead of searching for gold, they are developing the other discoveries . . . foremost among them plastics. But the contagious enthusiasm for plastics has led many misinformed people to make extravagant claims for plastics which resulted in their misuse. Mills' engineers avoid these errors through an accurate appraisal of both the possibilities and limitations of plastics. Let us serve you with this analysis that will lead either to the successful application of plastics to your product . . . or to advice on the correct choice of materials should the use of plastics be inadvisable. No obligation of course.

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TEXTILES FOR THE PLASTICS INDUSTRY

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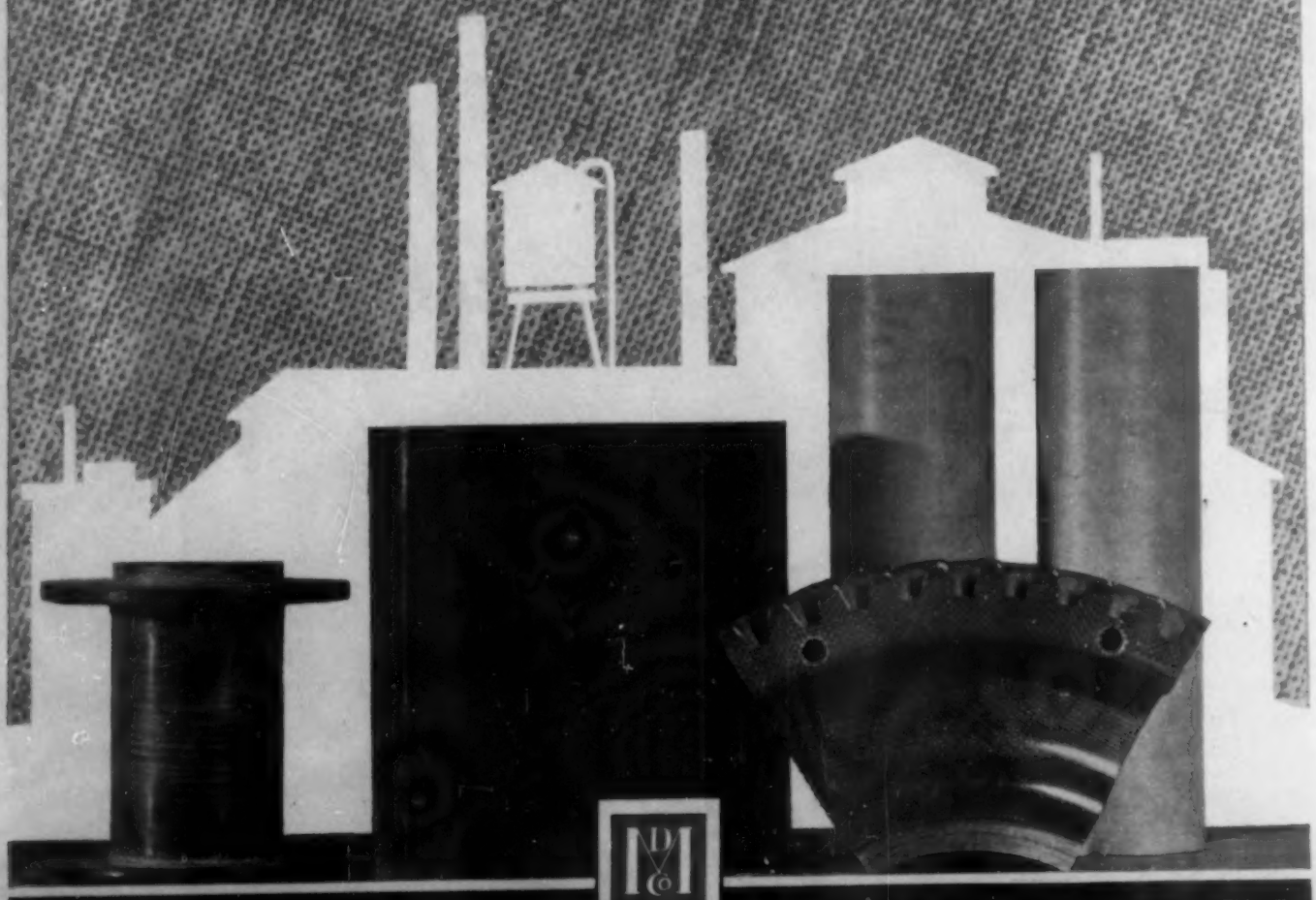

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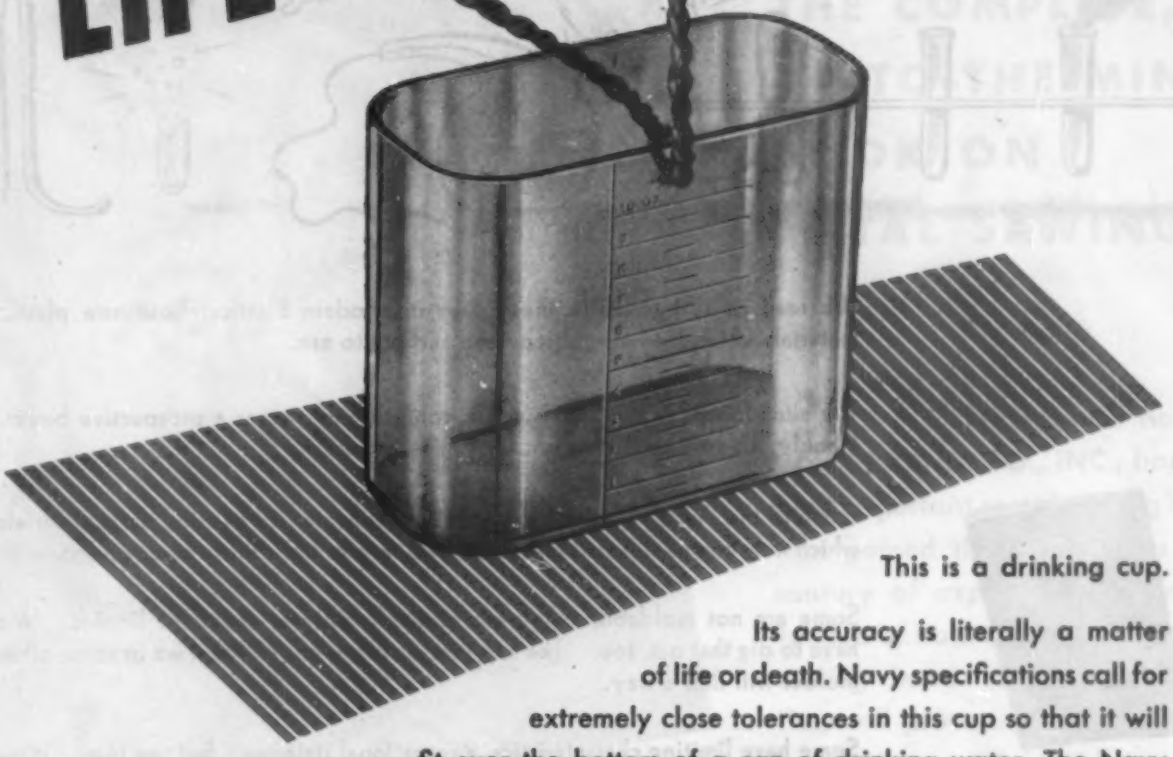
A matter of

LIFE or DEATH



This is a drinking cup.

Its accuracy is literally a matter of life or death. Navy specifications call for extremely close tolerances in this cup so that it will fit over the bottom of a can of drinking water. The Navy specifications also require extremely accurate calibrations, in a scale of 1 to 10 ounces, so that the precious life-giving fluid may be doled out in emergencies with extreme accuracy.

Rigidity and transparency are both important. The first so that no liquid may be spilled and the second so that measurements may be made exactly.

From the molder's point of view, the job is chiefly interesting as an exacting tool-making task which incorporates precise marking within the mold itself. The calibrations are molded integrally.

This is a CRUVER contribution to plastics in war—and a hint at their peacetime potential in the hands of a skilled molder.

Cruver MANUFACTURING COMPANY

2456 W. Jackson Blvd., Chicago, Ill.

New York N. Y. | Washington D. C. | Detroit Mich.

A MOLDER LOOKS AT SOME NEW PLASTICS

We read quite frequently these days in Modern Plastics about new plastic materials which are being discovered and put to use.

The situation probably seems rather confusing to you as a prospective buyer. Frankly, it's very confusing to us as professionals.

Some of the "new" products are merely new names for existing basic materials which new companies start making. We have to track those cases down.

Some are not moldable—they are available only as sheets or liquids. We have to dig that out, too. The supplier is always hopeful that we or some other molder will find a way.

Some have limiting characteristics, a sensational statement, but too true. How many raw material ads tell of the drawbacks and limitations?

Advertising "accentuates the positive and eliminates the negative," especially plastic advertising.

Your molder is the man to give you unbiased advice. He handles them all—and, of course—we would like to be that molder.

"A Ready Reference to Plastics" is our little introduction to the industry. We keep issuing new editions to incorporate the latest materials. The current one is pretty much up to date and we will be glad to give you a copy FREE if you are a business man or a Government employee.

BM CB

ARMY E NAVY

SPI

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IN this new handbook, W. O. BARNES CO., INC., has assembled important metal sawing information gained through over a quarter century of experience in the manufacture of hack saw blades and metal cutting band saws—complete data that will prove invaluable to all who work with metal.

This handbook was produced for YOU . . . offering suggestions and recommendations that will increase metal sawing efficiency in your plant . . . covering, too, the newest developments in band saws for light metals, plastics, laminates, etc.

Your copy of this handbook will be mailed immediately upon request, without charge or obligation. Write for it today.

ESTABLISHED 1919

W. O. BARNES CO., INC.

DETROIT 14, MICHIGAN

guide to the best use of plastics in postwar radios

How to take fullest advantage of all the new properties offered by the new plastics and the new formulations of older plastics, poses a real problem for every designer and planner of post-war radios and electronic equipment.

But there is a way. And that way, we believe, is through consultation with Monsanto plastics technicians. Monsanto, with one of the broadest and most versatile series of plastics in the whole industry, is in a particularly favorable position to lend expert, unbiased assistance.

For example, take these 24 different, basic plastic applications, typical of the hundreds that exist; in every one of them Monsanto is able to offer one or more plastics *especially suited* to that use.

ANTENNA INSULATOR
Styramic HT

CONSOLE CABINETS
Thalid impression molding

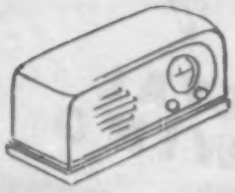
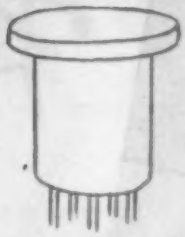
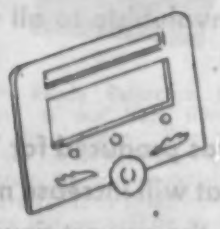


TABLE MODELS
Cerex • Resinox



COIL FORMS
Cerex • Lustron • Resinox
Styramic HT



ESCUTCHEONS
Thalid impression molding
Fibestos • Lustron • Resinox

GEARS
Laminates of Resinox

GRILLS
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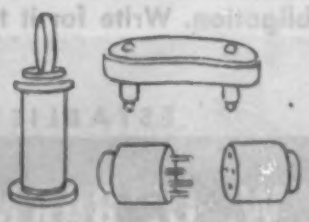
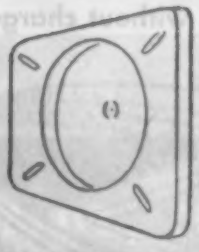
HEAD SETS
Resinox

TELEVISION OPTICAL LENS
Lustron



POWER PLUGS, JACKS, CONNECTORS
Resimene • Resinox • Cerex



SPEAKER CONE ASSEMBLIES
Resinox bonded pulp and paper
Thalid impression moldings

STAND-OFF INSULATORS
Cerex • Lustron
Styramic HT

MONSANTO PLASTICS FOR RADIO

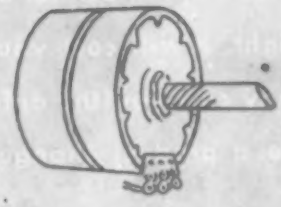
	Tensile Strength	Impact Resistance	Heat Resistance	Dimensional Stability	Electrical Insulation	Color Range	Forms* Supplied	Molding** Methods
CEREX	good	good	to 230° F.	excellent	excellent	extensive	MC	I, C, E
FIBESTOS (cellulose acetates)	good to excellent	excellent	to 120—160° F.	fair to good	good	unlimited	MC, S, R, T	I, C, E
LUSTRON (polystyrene)	good	good	to 180° F.	excellent	excellent	unlimited	MC	I, C, E
NITRON (cellulose nitrates)	very good	excellent	to 140° F.	good	fair	unlimited	S, R, T	Special methods
RESIMENE (melamine-formaldehydes)	very good to excellent	good	to 210—380° F.	excellent	excellent	all but lightest colors	MC, IR	C, T
RESINOX (phenol-formaldehydes)	good to very good	good to excellent	to 230—450° F.	excellent	good to excellent	darker colors only	MC, IR	C, T
STYRAMIC HT (Polydichlorostyrene)	good	good	to 236° F.	excellent	the best	unlimited	MC	I, C, E
STYRAMIC (modified polystyrene)	good	good	to 184—187° F.	excellent	excellent	unlimited	MC	I, C, E
THALID	Completely reactive thermosetting resin for impression molding. Bonds glass cloth, fabric or paper into large panels or integrated forms in short curing cycles, with low temperatures and no pressures. Material is rigid, insoluble, fusible, highly resistant to abrasion, heat and water.							

*MC—molding compounds S—sheets R—rods T—tubes IR—industrial resins
**I—injection C—compression E—extrusion T—transfer, form of compression

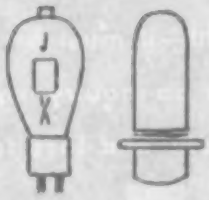
If you have the responsibility for getting the most out of the materials that go into your company's equipment, it may pay you well to check over this chart now. Then if you have more questions, call on a Monsanto consultant; he will help you put your finger on the right plastic, and the right way to use it. Write, wire or phone: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield 2, Massachusetts.

MONSANTO PLASTICS
SERVING INDUSTRY...WHICH SERVES MANKIND

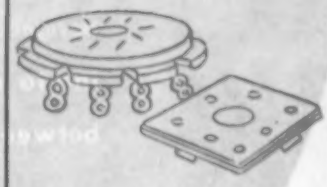
STATIC ELIMINATOR HOUSINGS
Resinox



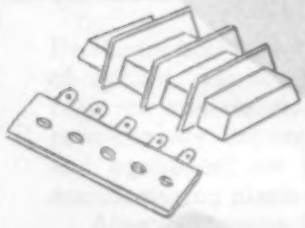
SWITCH AND CONTROL PARTS
Resinox molded • Resimene



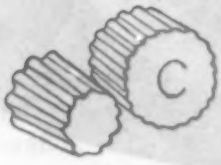
TUBE BASES
Resinox molded bases
Resinox cements



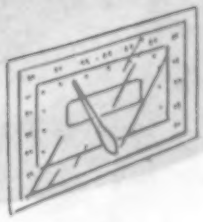
TUBE SOCKETS
Cerex • Lustron
Laminates of Resinox



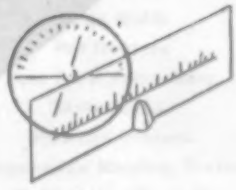
CONNECTOR AND TERMINAL STRIPS
Resinox molded
Laminates of Resinox



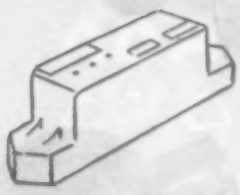
CONTROL KNOBS
Fibestos • Lustron • Resinox



CRYSTALS
Fibestos

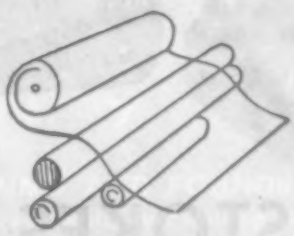


DIALS
Fibestos • printed scales
Lustron • molded scales



HOUSINGS, RELAY-SWITCH, CAPACITORS
Cerex • Resinox
Resimene • Styramic HT

INDUCTANCE BEADS
Cerex • Lustron • Styramic



INSULATING PARTS
Lustron

INSULATOR WASHERS, BUSHINGS
Resinox • Laminates of Resinox

Changing Blueprints into Profits

Many products now on the drawing boards of American industry call for the use of plastics. That is where Stokes comes in. For a product to be profitable, it must not only be *designed* right—it must be *built* right. It will cost you nothing to make an inquiry *now*. It may cost you the difference between profit and loss to make a product change later.

JOS. **STOKES RUBBER** CO.

Molders of Hard Rubber and Plastics • *Since 1897*

TRENTON, N. J.

In Canada: Jos. **STOKES RUBBER** Co., Ltd., WELLAND, ONT.

Serving the *INDUSTRY* Since 1892

Designers and Builders of
STANDARD AND SPECIAL MACHINERY
For the Processing of
Rubber, Plastics and Plywood

Designers and builders of basic machinery used in the manufacture of rubber, plastics and plywood, ADAMSON, through constant research and development, has contributed many outstanding and revolutionary improvements to the industry. ADAMSON processes and equipment are in operation in many of the country's largest manufacturing plants.

Always possessed of adequate production facilities, recent reorganization and expansion provide even greater manufacturing capacity and a more comprehensive engineering and research service for the development of new processes and equipment.

Consult us. Our experience and abilities are at your service.

PRODUCTS MANUFACTURED BY ADAMSON UNITED

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- Colloidal Mills
- Large Molds
- Pot Heaters
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- Autoclaves
- Plywood Presses
- Compression Molding Presses
- Multi-Platen Presses
- Automatic Curing Presses
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ADAMSON UNITED COMPANY

SUBSIDIARY OF UNITED ENGINEERING AND FOUNDRY COMPANY

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AFFILIATES: DAVY AND UNITED ENGINEERING COMPANY, LTD., SHEFFIELD, ENGLAND
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AKRON, OHIO

We're ready to think and talk with you about civilian industrial applications

The fighting war is half over but the necessity for Panelyte production for Victory is *greater* now than it has ever been.

We have been assigned an "Approved" Quality Control Rating by the Air Technical Command, which abolishes the need for official Army Air Forces product inspection and acceptance. We have assumed full responsibility for the excellence of Panelyte molded and fabricated parts required. And, we are shooting for another "star" in our Army Navy "E" Flag.

However, we will *make* time to discuss with you *now* the design and mass production of molded and fabricated parts so that no time will be lost getting into civilian production. We are fortunate in that no reconversion is necessary in order to start peacetime industrial production. Your inquiry will have prompt attention.

PANELYTE *the structural plastic*

PANELYTE DIVISION
ST. REGIS PAPER COMPANY
230 PARK AVENUE
NEW YORK 17, N. Y.

Sales Offices: Atlanta, Boston, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Kansas City, Los Angeles, Mexico City, Montreal, New Orleans, Phoenix, Portland, St. Louis, St. Paul, San Francisco, Seattle, Syracuse, Toronto, Trenton, Vancouver.

★ MASS PRODUCTION OF SHEETS, RODS, TUBES, MOLDED FORMS, FABRICATED PARTS IN PAPER, FABRIC, FIBRE GLASS, WOOD VENEER AND ASBESTOS BASE LAMINATES

SCALES...SLIDE RULES OF DU PONT "LUCITE"

More accurate... longer-lived... produced 700 times faster!

UNTIL recently, it took 2 years to make an accurate slide rule. Today, by making them of injection-molded Du Pont "Lucite" instead of wood, it is done in 24 hours!

The delay in the old method was caused by the need of seasoning the wood to make it stable enough to retain accuracy . . . to avoid shrinking or twisting. A 5-inch slide rule has over 1600 lines, many of them but 0.003 inch apart.

But instruments of "Lucite" methyl methacrylate resin do not shrink . . . do not twist. Low moisture-absorption keeps them true even in humid climates. The slide rules—and engineers' protractors and scales also—molded of "Lucite" have greater accuracy than the best of the wooden instruments. Accuracy is held to a tolerance of 0.0005 inch per inch between the tiny lines.

"Lucite" today is working to help win the war. Quantities can be had for experimental purposes. Address: E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J.

FOR PLASTICS . . CONSULT DU PONT

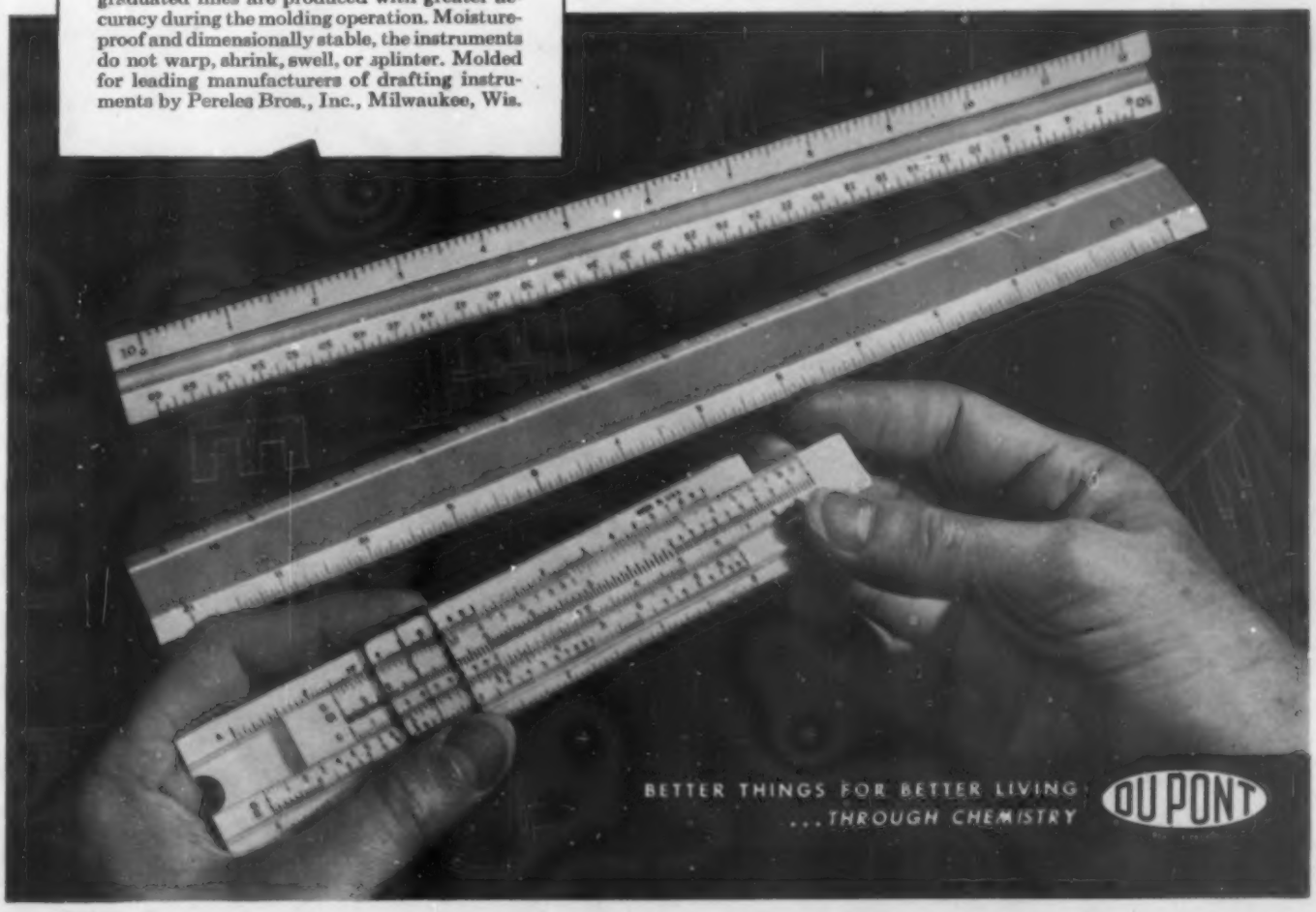
Always the Best Buy—WAR BONDS

THE OLD WAY

AGING AND CURING FOR TWO YEARS is required for slide rules, engineers' scales and protractors made of boxwood.

THE NEW WAY

TODAY'S INSTRUMENTS molded of "Lucite" are completed in 24 hours. Hundreds of finely graduated lines are produced with greater accuracy during the molding operation. Moisture-proof and dimensionally stable, the instruments do not warp, shrink, swell, or splinter. Molded for leading manufacturers of drafting instruments by Pereles Bros., Inc., Milwaukee, Wis.



Design engineers looking for peak efficiency and long life in fractional H.P. motors, will pick a QUIET motor—A BALLENTINE MOTOR. Because only skilled craftsmanship, strict adherence to close tolerances, *precision dynamic balance* plus modern manufacturing methods and equipment can produce a truly QUIET motor. In BALLENTINE MOTORS, the engineer finds all these factors—*at their best*—combined with suitable mechanical and electrical design. *Quiet* BALLENTINE MOTORS are available in ratings from 1/1000 to 1/6 H.P.—adapted to your specific application. Write for descriptive bulletin.

RUSSELL ELECTRIC COMPANY

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Manufacturers of **BALLENTINE MOTORS**

GLASS

to spin a spiderweb of rayon

OR TO MAKE ACCURATE CHEMICAL ANALYSES

TYPICAL of modern applications of Corning developed glasses are the godet wheels for the rayon industry and the crucibles used by research chemists and laboratory technicians.

Corning produces PYREX Brand Glass godet wheels that can be made to the closest tolerances, rugged enough for day in and day out service, and possessing the surface smoothness, abrasion and corrosion resistance essential in textile manufacturing processes.

Vycor Brand Ware, fabricated from 96% Silica Glass No. 790, has proved to be the most versatile of all laboratory ware. Exceptional chemical stability, high softening point and extremely high resistance to heat shock are its outstanding qualities. Reactions can be carried on with greater speed and accuracy—opening new fields to the scientist.

Corning research has developed thousands of different glass compositions—each possessing the valuable properties of glass, in countless combinations and in a wide range of values. Corning engineers are prepared to assist in product design to meet your special requirements. The comprehensive fabricating facilities of Corning—from hand operations to mass production machinery—make possible the production of quality glassware in any required quantity. Perhaps glass is the answer to one of your problems. Write today to the Industrial Sales Department, MP8, Corning Glass Works, Corning, New York. Your inquiry will receive prompt attention.

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Research in Glass
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"PYREX" and "CORNING" ARE REGISTERED TRADE MARKS AND INDICATE MANUFACTURE BY CORNING GLASS WORKS, CORNING, N.Y.

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Please send me a copy of your Bulletin 842—
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Preform Presses

. . . Choice of the Plastics Industry Since Its Beginning

GENERAL PURPOSE

HIGH PRODUCTION

HEAVY DUTY

STOKES Preform Presses are preferred equipment in modern molding plants. They meet present-day demands for larger preforms . . . for rugged machines that withstand hard service in long production runs. They offer a wide choice of equipment from which to select presses to best meet individual requirements.

For Large Preforms up to 4" dia., the heavy-duty Stokes No. 280 is recommended . . . a toggle-type press, with 4" die fill, applying up to 80 tons pressure. Other presses are available for pressures from 100 to 300 tons capacity.

For Large Output use a Rotary type press . . . makes balls or standard shapes up to 1 3/16" dia. at 300 to 350 per min. We build eight different models and sizes of this type press with output up to 1000 per minute.

For General-Purpose Preforming we offer versatile Single Punch Presses, readily changed from one job to another. Four models. The "R" machine shown has 2" die fill, makes preforms up to 2½" dia. at production rates up to 50 per minute.

Stokes Preform Presses are rugged, of semi-steel construction, with working parts thoroughly protected from dust. Equipped with Automatic Excess Pressure Release, to prevent jamming. Easily adjusted for preform hardness and weight.

F. J. STOKES MACHINE CO.
5934 Tabor Road Philadelphia 20, Pa.

For complete description of above and other Stokes Presses, write for copy of Molding Catalog No. 427—showing illustrations and specifications on ten popular models of single punch and rotary type preform presses.

50th year of Service to Industry

F.J.Stokes MOLDING EQUIPMENT FJS

NORTON LABORATORIES (INCORPORATED)

CUSTOM MOULDERS OF SYNTHETIC PLASTICS
BAKELITE DUREZ

LOCKPORT, N.Y.

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ALL AGREEMENTS ARE CONTINGENT UPON STRIKES, FIRES, ACCIDENTS OR CAUSES BEYOND OUR CONTROL. CONTRACTS WITH AGENTS NOT VALID UNTIL APPROVED BY AN OFFICER.

August 1945

Dear Plastics User:

Every once in a while we take inventory in our plant—to see how many barrels of molding powder, how many machines and how much general equipment we have in working order.

At the same time, we like to take stock of ourselves to see if we are working as efficiently as possible and serving our customers' needs as satisfactorily as possible.

We pass our little inventory on for your edification: Item: a well established plant. Item: a well equipped and well built factory. Item: an organization that has long industrial experience and long experience in working together. Item: Norton is known as a company who are responsible molders of plastics. Item: our customers, many of whom we have served for a long time, include some of the best names in America.

These are a few of the reasons we think, why you should consider us as your source of molded plastics.

Sincerely yours,

M. L. Seekins

M. L. SEEKINS,
Factory Manager

PLASTICS TESTING

IS *Quality* INSURANCE

You don't buy insurance because you expect to have a fire... it's simply protection. And the same with a steady program of Plastics Testing. ★ Through Testing you keep your Plastics in the forefront of progress... it tells you whether your Plastics are meeting serviceability requirements... it provides you with the facts you need in purchasing, manufacturing, and selling. ★ The United States Testing Company, Inc., has facilities for Testing Plastics on a chemical, physical, or electrical basis... or to solve problems of practical application. The following is but one of our many special Plastics Tests:

CERTIFIED MERCHANDISE · UNITED STATES TESTING CO. INC. · SEAL OF QUALITY

TESTING PLASTICS FOR USE IN INSULATION BOARD

Many new types of Plastics are being considered for insulating purposes. Included are the expanded, molded, laminated, and paper types. Our Tests on Plastics for use in insulation board cover: Thermal Conductivity ★ Resistance to Moisture ★ Resistance to Mildew ★ Resistance to Vermin.

UNITED STATES TESTING COMPANY, INC.

ESTABLISHED 1880

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RESIN PERFORMANCE

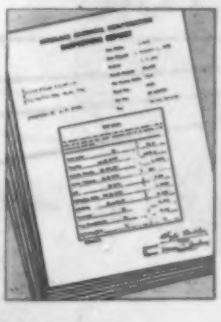
is a function of *specific* adaptation of:

The failure to correlate fully ALL of the above factors is the source of most of user's resin troubles.

INTERLAKE CHEMICAL CORPORATION—while developing, adjusting and production-stabilizing a resin for a specific application—to obtain *and maintain* exact, desired resin properties—works *with your production men, in your plant,* to test and perfect that resin in actual application under normal conditions of use.

That's why many important industrial users call upon Interlake when contemplating new resin applications—or—when a presently used resin is *not* performing with maximum efficiency.

IF YOU HAVE A RESIN PROBLEM, draw freely upon the wide experience of Interlake. We will gladly work with you on any resin problem, or discuss with you the possible advantage of using resins in any operation or process. Write Interlake Chemical Corporation, Plastics Division, 1911 Union Commerce Building, Cleveland 14, Ohio.



CONTROLLED UNIFORMITY

When Interlake has developed a resin for your specific application, thereafter *each shipment* of that resin carries its own Control Laboratory report evidencing the *extremely close range of variation* within which it has been held. Thus you can be sure of the uniformity in performance of every shipment.

INTERLAKE CHEMICAL
Corporation
PLASTICS DIVISION

Specificity IN RESINS

An up-to-date summary of the properties of

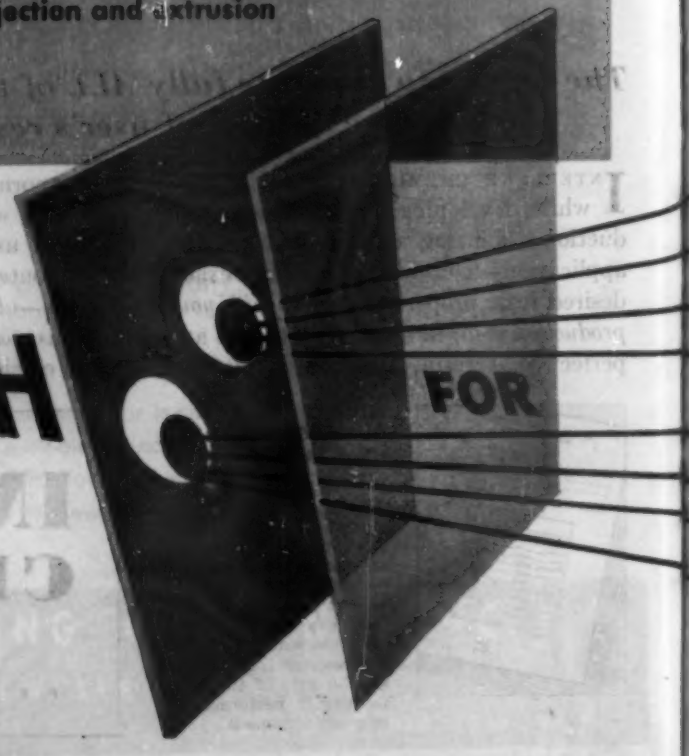
Celanese* Plastics

While there is no such thing as an all-purpose plastic, experience proves that the cellulosic plastics are suited to a wider range of applications than any other type. In addition to their outstanding and widely recognized advantages, recent developments and improvements in the cellulosics have increased the scope of their usefulness. Within the Celanese group of cellulosic thermoplastics, there are types and formulations which offer physical properties that bracket the full range of cellulosic plastics possibilities.

TOUGHNESS Toughness in the cellulosic plastics is inherent; it is achieved without supporting filler of any kind. Among the cellulosics, Celanese plastics are unexcelled for toughness.

UNLIMITED COLOR Sixty years of color experience that began with the first plastic "Celluloid"* is the background for the unlimited color and accurate color control available in Celanese plastics. The result is a range of colors, configurations, mottles and color densities that is surpassed by no other group of plastics.

MOLDABILITY Moldability is an outstanding characteristic of Celanese plastics. They are adaptable to the fastest injection and extrusion as well as other molding methods.



LOOK INTO LUMARITH

EASE OF FABRICATION There are, perhaps, more fabricating methods open to Celanese plastics than to any other plastics group. They can be cut, sawed, drilled, heat formed, machined, laminated, blown . . .

TOUCH COMFORT Low thermal conductivity is the property that makes Celanese plastics pleasant to the touch. They are never too hot or too cold.

SURFACE PERMANENCE Clear-through color, absence of filler and good surface hardness all contribute to the surface permanence of Celanese plastics parts. Usage actually improves their lustre and appearance.

NON-REVERBERATING Celanese plastics have pronounced sound-absorbing characteristics. Molded and fabricated articles have no unpleasant clatter or ring.

HEAT RESISTANCE The ability to soften under heat without decomposing is the basis of the superb moldability of Celanese plastics. This chemical heat stability is an important part of the resistance of Lumarith plastics parts to the higher operating temperatures.

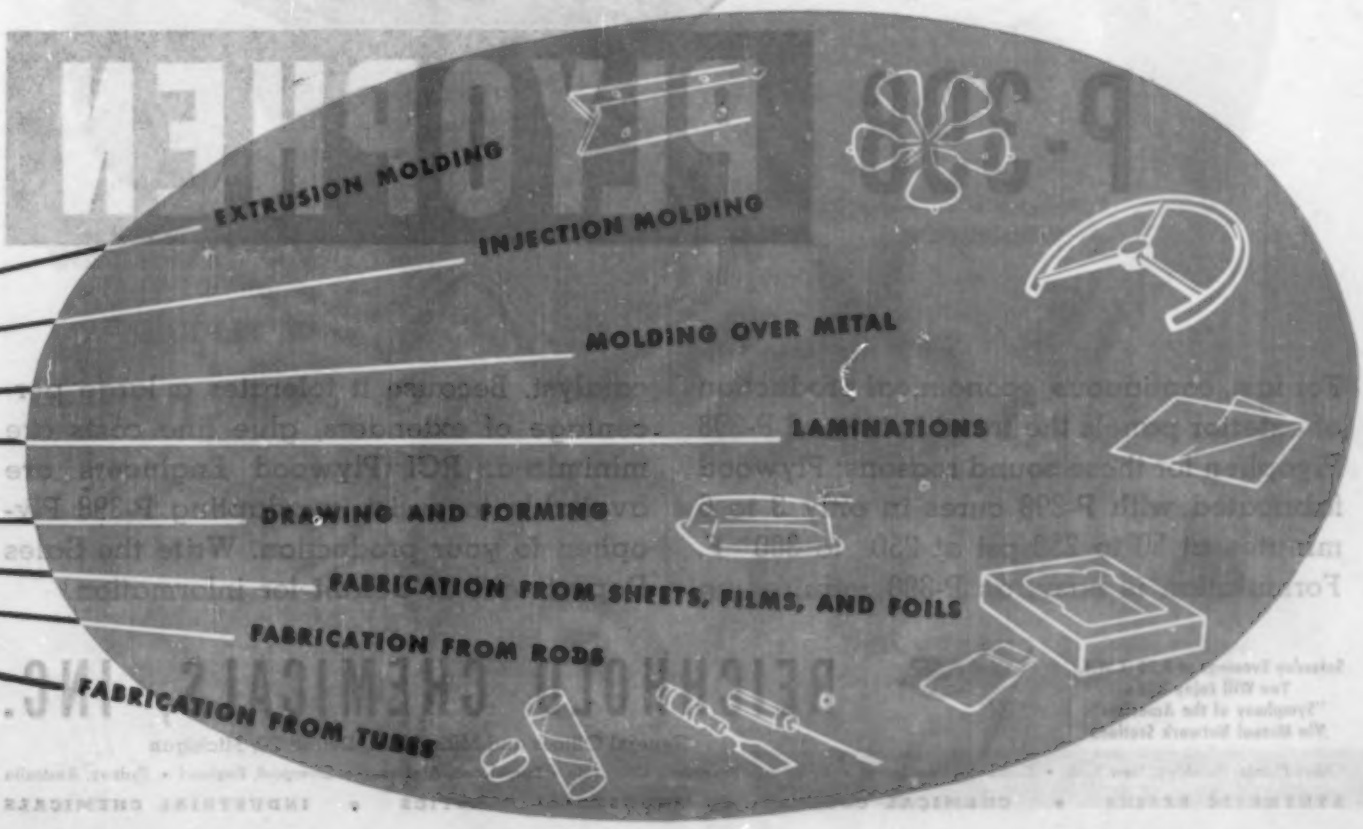
WARPAGE RESISTANCE Lumarith® EC (ethyl cellulose) is the most dimensionally stable of the cellulosics. Military applications of Lumarith EC have demonstrated this stability both in the dry cold of the Arctic and the humidity and heat of the Tropics.

LIGHT WEIGHT The specific gravity of Celanese plastics formulations range from 1.07 to 1.40—lightness which permits greater bulk and consequently greater strength in many applications.

TRANSPARENCY Celanese plastics rank high in the property of transparency. Light transmission is as high as 98% of the theoretical maximum (92% absolute) for a sheet approximately .125" in thickness. Index of refraction is 1.49. The spectral transmission can be modified to include or exclude the ultra-violet rays. Celanese plastics are not subject to stress crazing that affects strength as well as transparency.

WIDE RANGE OF FORMULATIONS Success with plastics depends upon the right plastic and the right formulation. Celanese welcomes every opportunity to assist you in the selection of the right plastic for best results. Should a study of your product and problem indicate the need of other than a Celanese plastic, you can count on the Celanese technical staff and sales organization for impartial advice. Celanese Plastics Corporation, *a division of Celanese Corporation of America*, 180 Madison Avenue, New York 16, N. Y.

®Reg. U. S. Pat. Off.



WORLD'S LARGEST PRODUCER OF SYNTHETIC RESINS

RCI

For full speed ahead

on Exterior Panel Production

P-398 PLYOPHEN

For fast, continuous, *economical* production of exterior panels the trend is toward P-398 Plyophen for these sound reasons: Plywood fabricated with P-398 cures in only 3 to 6 minutes at 50 to 250 psi at 250° to 300° F. Formulation is easy, as P-398 requires no catalyst. Because it tolerates a large percentage of extenders, glue line costs are minimized. RCI Plywood Engineers are available to assist in adapting P-398 Plyophen to your production. Write the Sales Department at Detroit for information.

Saturday Evenings at 8:30 (E.W.T.)
You Will Enjoy RCI's
"Symphony of the Americas"
Via Mutual Network Stations

REICHHOLD CHEMICALS, INC.

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SYNTHETIC RESINS • CHEMICAL COLORS • INDUSTRIAL PLASTICS • INDUSTRIAL CHEMICALS

Menu for the Day

"SOLDERING SPECIALTY"

served between

Two Pieces of Plastic

The chef, in this case Weller Mfg. Co., of Easton, Pa., makes his Sizzling Platter very tempting, indeed! The heating element is sandwiched between two compression-molded halves of plastic. These, fitted together, form a complete, protective, pistol-type housing. It remains cool to the hand, permits the fingers to stay on the trigger control and greatly enhances the item's tool-like appearance. • Inquiries invited from those whose present problems and postwar plans have reached the thinking-out stage. Consolidated guarantees your blueprint in plastic—the right plastic!

COMPRESSION molding

TRANSFER molding

INJECTION molding

"YOUR BLUEPRINT IN PLASTIC"

Consolidated

MOLDED PRODUCTS Corporation

309 CHERRY STREET, SCRANTON 2, PA

Branches NEW YORK · CHICAGO · DETROIT · BRIDGEPORT · CLEVELAND

PLASTIC PARTS

. . . . PRODUCED TO YOUR SPECIFICATIONS

PRINTING
DIE CUTTING
CEMENTING

Wide experience by all known processes in the application of printing, engraving, silk screening, die cutting and cementing of all thermoplastics.

FORMING

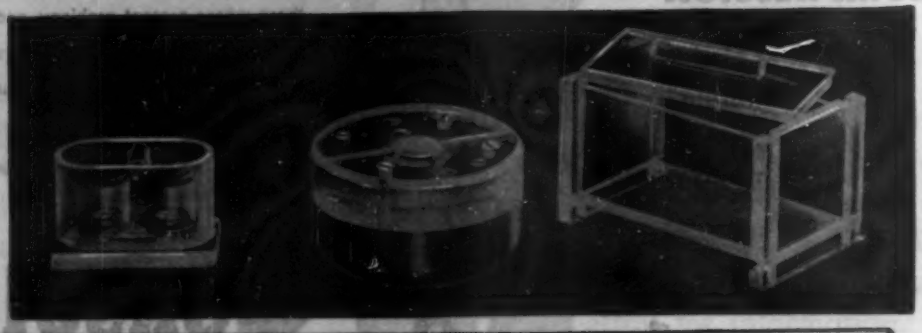
Specialists in deep drawing radio dial windows, embossing, swaging and bending in Acetate, Vinylite and Acrylics.

MACHINING

Precision threading, screw machine, milling, drilling, turning of Polystyrene, Acrylics, Phenolics, Nylon, Tenite; sheets, tubes and rods; through spindle capacity up to 2½" rod.

ASSEMBLY

Our engineers can assist you in problems of design and assembly of your plastic units.



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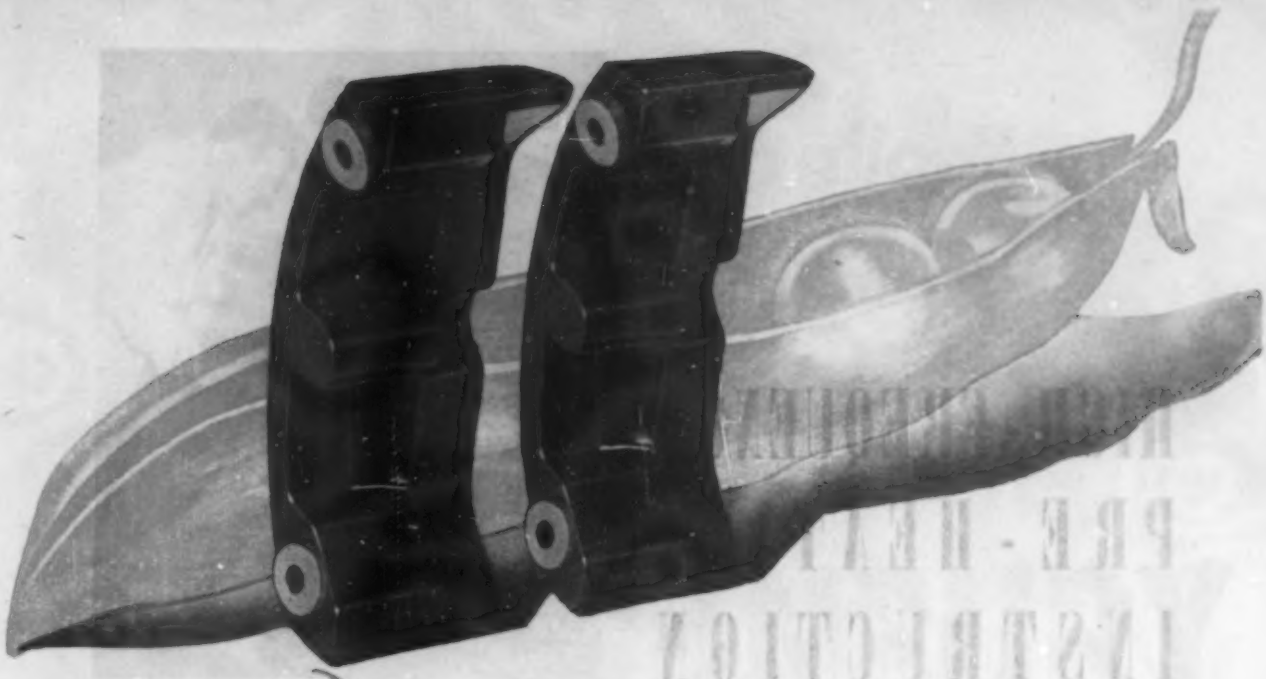

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To a good plastics molder, there is no monotony in sameness.

General Industries produces molded plastic parts with that precise uniformity which insures faster, more economical assembly and dependable performance of finished products. Our experienced operators and modern facilities for compression, transfer and injection molding can handle the production of large parts or small, in any quantity.

When the present load of military production is relieved, we shall once again stand ready to offer you the experience and equipment necessary to help mold salability and satisfaction into your postwar products.

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Molded Plastics Division

ELYRIA, OHIO

Chicago:	**Phone Central 8431**
Detroit:	**Phone Madison 2146**
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THE GENERAL INDUSTRIES COMPANY MOLDED PLASTICS

HIGH-FREQUENCY PRE-HEATING INSTRUCTION

being emphasized at

PLASTICS INDUSTRIES TECHNICAL INSTITUTE

Kennith V. Tindall (left), electronics expert, explains the function of a radio-frequency generator to students at Plastics Institute.

Because of the growing importance of heatronic molding within the plastics industry, Plastics Industries Technical Institute has expanded its program of instruction in this subject by engaging the services of Kennith V. Tindall, electronics expert, to give students practical demonstrations and lectures covering the latest developments in this technique. Mr. Tindall has a background of ten years' experience in industrial electronics and is presently engaged as Chief Sales and Applications Engineer with a well-known manufacturer of preheating equipment for the plastics field.

This emphasis upon heatronic molding is further evidence of the constant effort made by Plastics Institute to provide modern, practical, plastics training of maximum value to its students and the plastics industry. We cordially invite your inquiries regarding resident training and the home study course.

VETERANS ELIGIBLE FOR G. I. TRAINING

A number of World War II Veterans are taking advantage of the educational provisions in the G. I. Bill of Rights to receive practical training at Plastics Industries Technical Institute. To any of your former employees returning as veterans or to any other servicemen who are interested in obtaining plastics education—we will be happy to send information explaining their privileges and details concerning our training program. Please write us.

Plastics INDUSTRIES TECHNICAL INSTITUTE

Francis A. Gudger, President · John Delmonte, Technical Director

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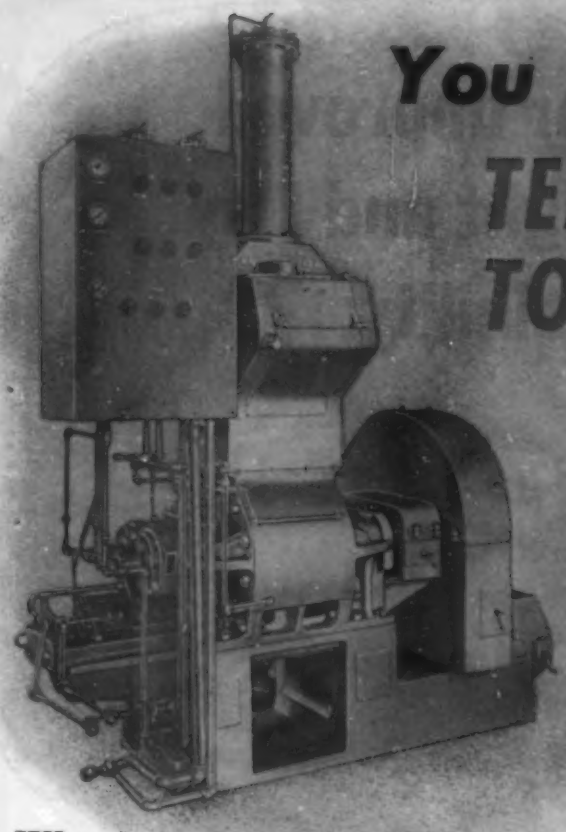


You can "tailor" TEMPERATURE TO FIT THE PLASTIC with a BANBURY

With a Banbury Mixer you can accurately control the batch temperature for whatever plastics stock you are processing.

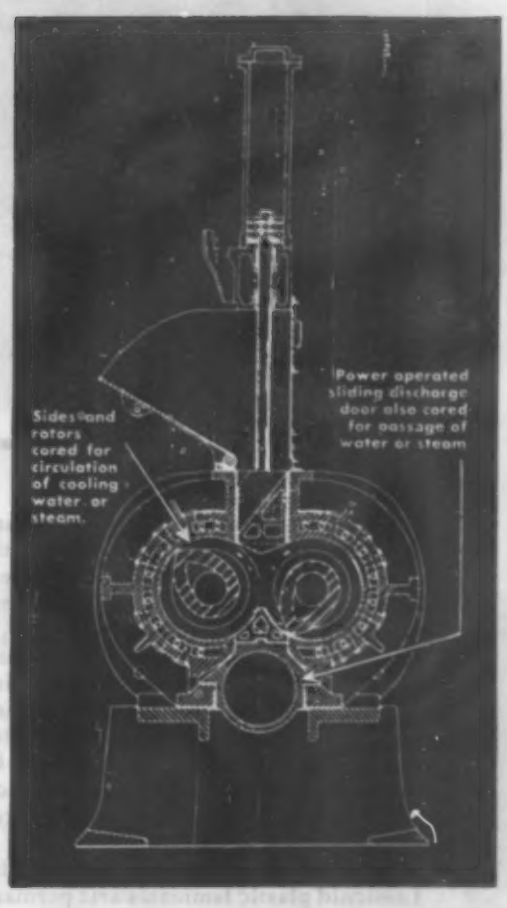
There are several features of Banbury design which make this possible. Essentially, the machine consists of a completely enclosed mixing chamber in which two rotors operate, a hopper to receive the materials for mixing, and a sliding door for discharging the batch. The chamber walls, rotors and sliding door are cored for circulation of steam, cooling water or other temperature controlling mediu.n. This means that practically the entire surface in contact with the batch is put to use in keeping the temperature under close control.

An electrically actuated potentiometer pyrometer, with its sensitive element, a thermocouple, in direct contact with the batch, indicates and records the temperature on a chart. Valves and gauges for the various temperature regulating circuits are mounted on a panel at the operating platform. By manipulating them it is a simple matter to bring the batch temperature to the desired point and keep it there.

Another important control device supplied with all production size Banburys is the telechron-motor-operated timing instrument which automatically signals the operator as each stage of the operating cycle is completed.

Optional equipment includes an automatic discharge control, operated either by the timing device or the temperature control. This mechanism automatically opens the door and keeps it open long enough for complete discharge of the batch.

Banbury Mixers are built in nine sizes for laboratory and factory use. For complete information write for Bulletin No. 180.


Power operated sliding discharge door also cored for passage of water or steam
Sides and rotors cored for circulation of cooling water or steam.

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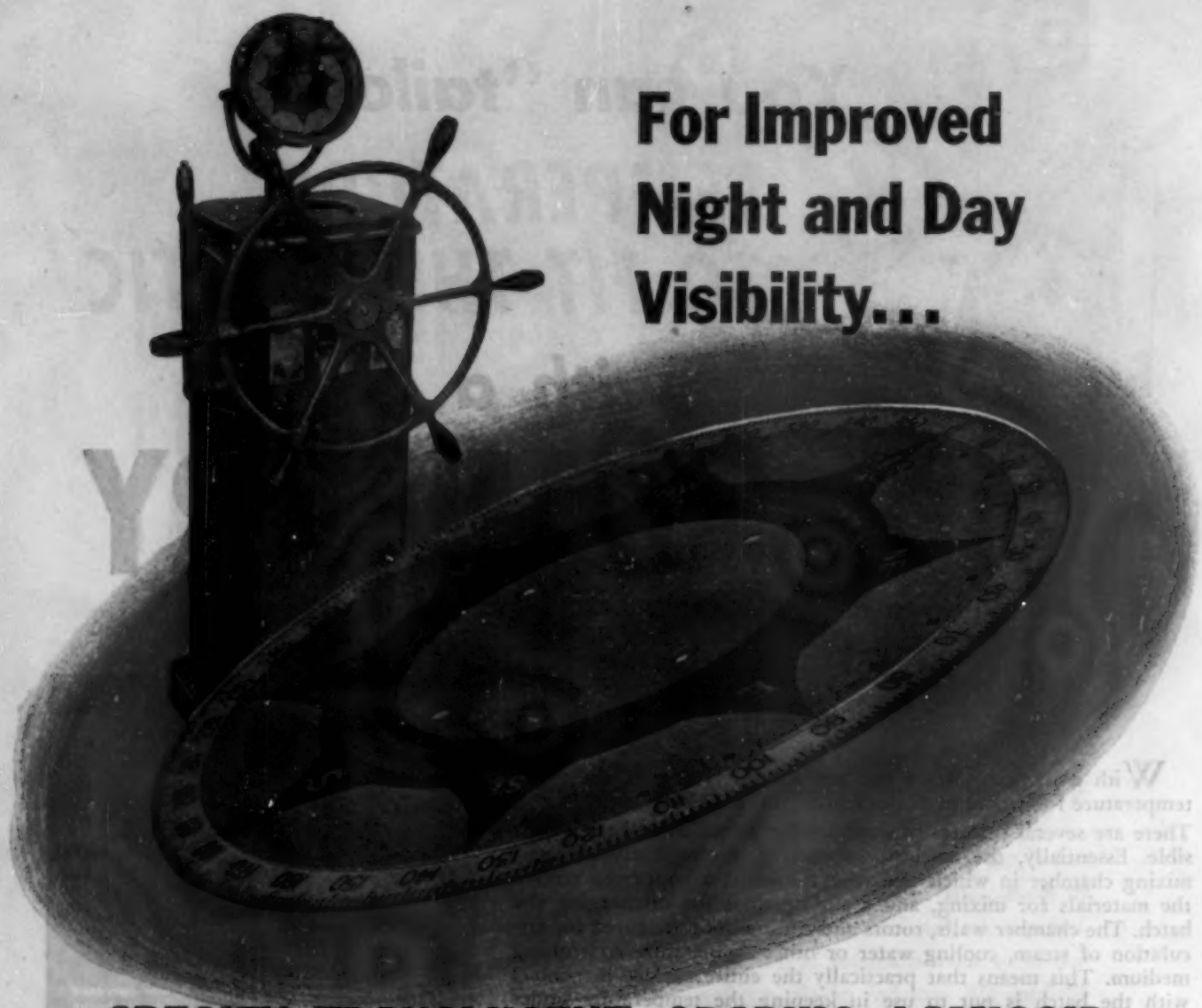

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Translucent Graphic Lamicoid is an excellent choice for dials that require a combination of colors with rear illumination. Better visibility for dials on instruments, electronic or electric equipment helps operators make more accurate readings with less eye strain.

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But Translucent Graphic Lamicoid is only one of three types available. Opaque Rigid and Opaque Flexible complete this group of "graphic" Lamicoid grades having printed matter permanently laminated in the thermo-setting plastic sheet.

Mica Insulator Company also makes Engraving and Translucent Lamicoid in various opaque or translucent types. For complete information, write or call our nearest sales office. Our fabricators are strategically located throughout the country for quick service.

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Glycerine (C. P.) has—*A pleasant, sweet taste.* High sweetening power. No bitter aftertaste.

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Humectant properties—in the right degree. Glycerine helps keep your product in its original fresh condition. Its low vapor pressure makes it "stay put."

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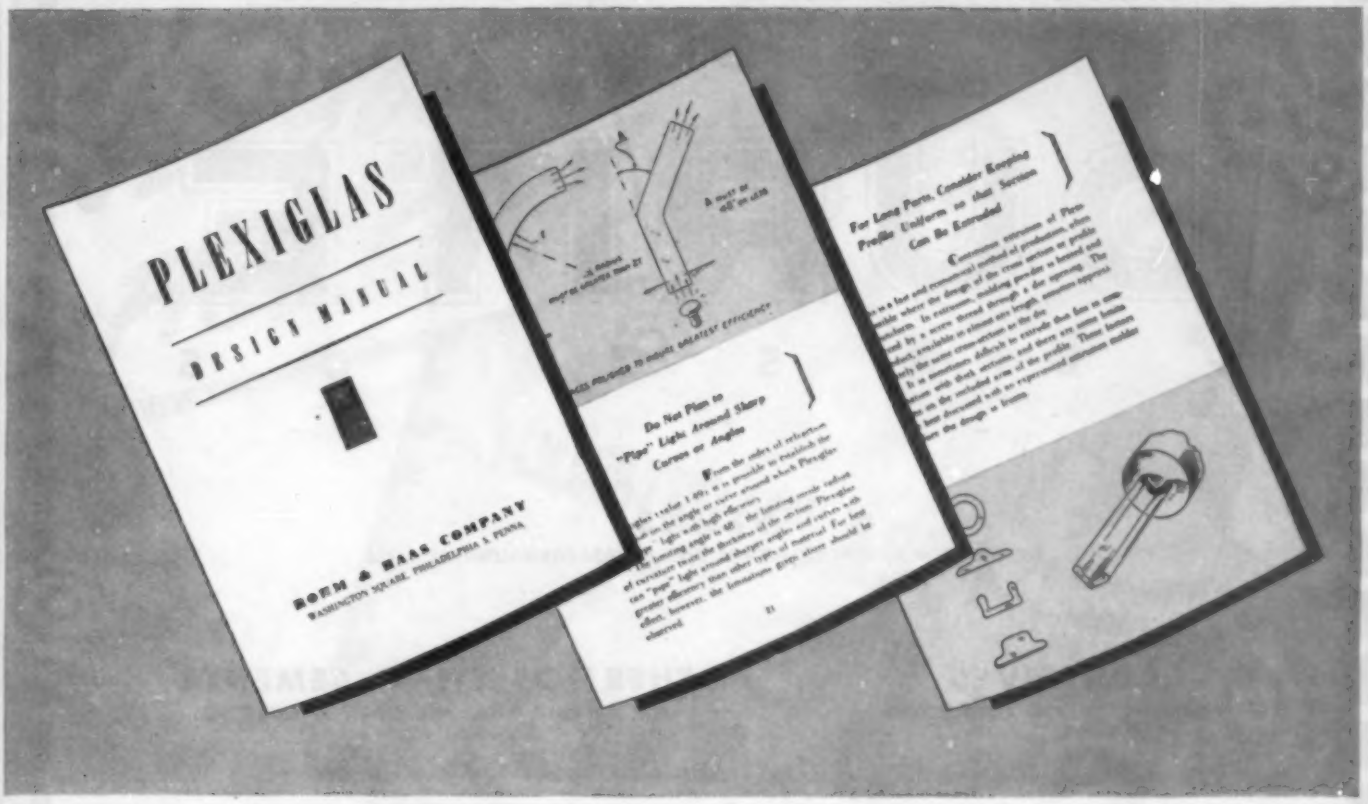
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For Long Parts, Consider Keeping Profile Uniform so that Section Can Be Extruded

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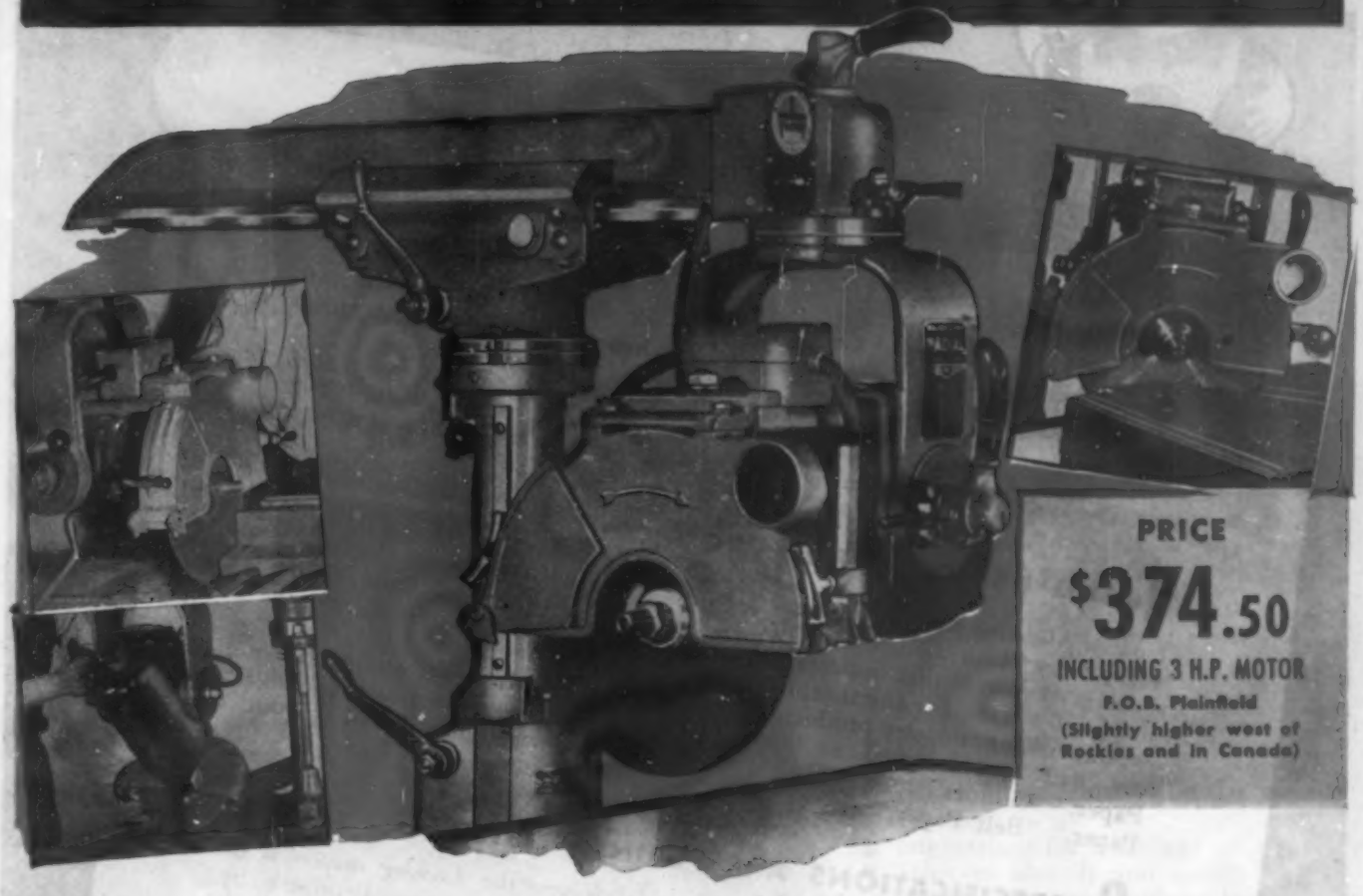

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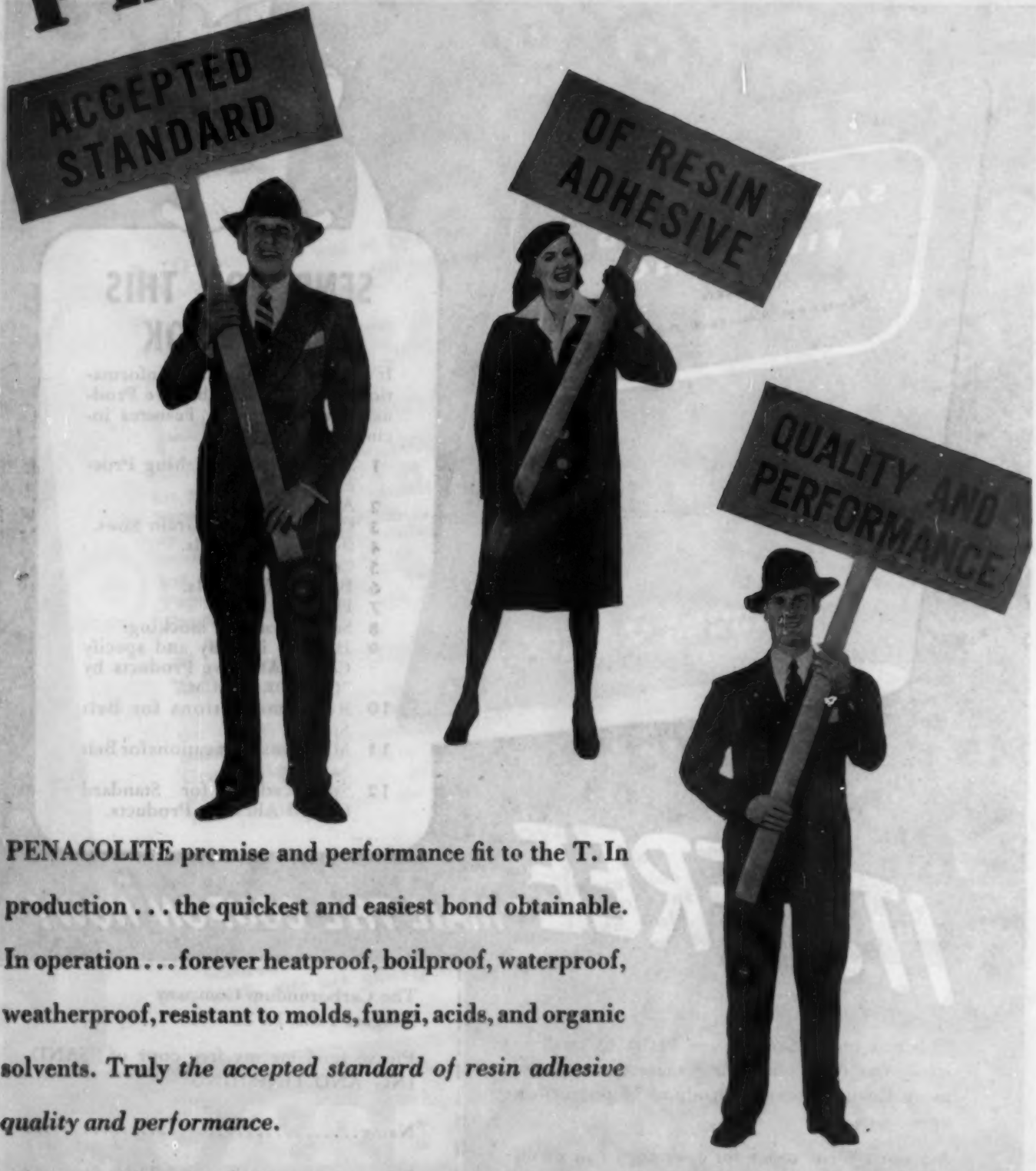

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The Modern Method For Applying *Plastics* To Fibers and Fabrics

Reduced Reproduction of pages from "Plastics Survey" by C. Norris Rabold, published in Textile World.

ROSS* Treating Systems

The volume and variety of remarkable new materials being developed through the application of synthetic resins to cloth and paper grows steadily.

As pointed out in the "Plastics Survey" recently published in TEXTILE WORLD, the method of application, depending upon the properties of the plastic, usually involves the operation of coating or impregnating the fibers or fabric, then properly drying or curing the treated material.

The ROSS* Treater System is designed to handle all required operations from unroll, thru mechanical treating and air processing to the final re-roll with speed and complete uniformity of product assured.

Inquire about the advantages of this scientifically engineered apparatus for your product or process.

* In the ROSS Treater System illustrated, the mechanical treating apparatus by JOHN WALDRON CORPORATION operates in tandem with the air processing apparatus by J. O. ROSS ENGINEERING CORPORATION.

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One of the largest producers of phenolic resins uses this 200 ton Lake Erie Hydraulic Press to prove under actual manufacturing conditions the qualities of their molding compounds.

From it has come many of the advancements in product development and methods of molding the versatile materials which they supply to other manufacturers.

Realizing the great future of plastics Lake Erie engineers have made a thorough study of all types of fabricating methods. Already we have designed standard compression molding presses that can be adapted to your needs—or we can build presses to meet any special production methods you may require. Write for complete information.

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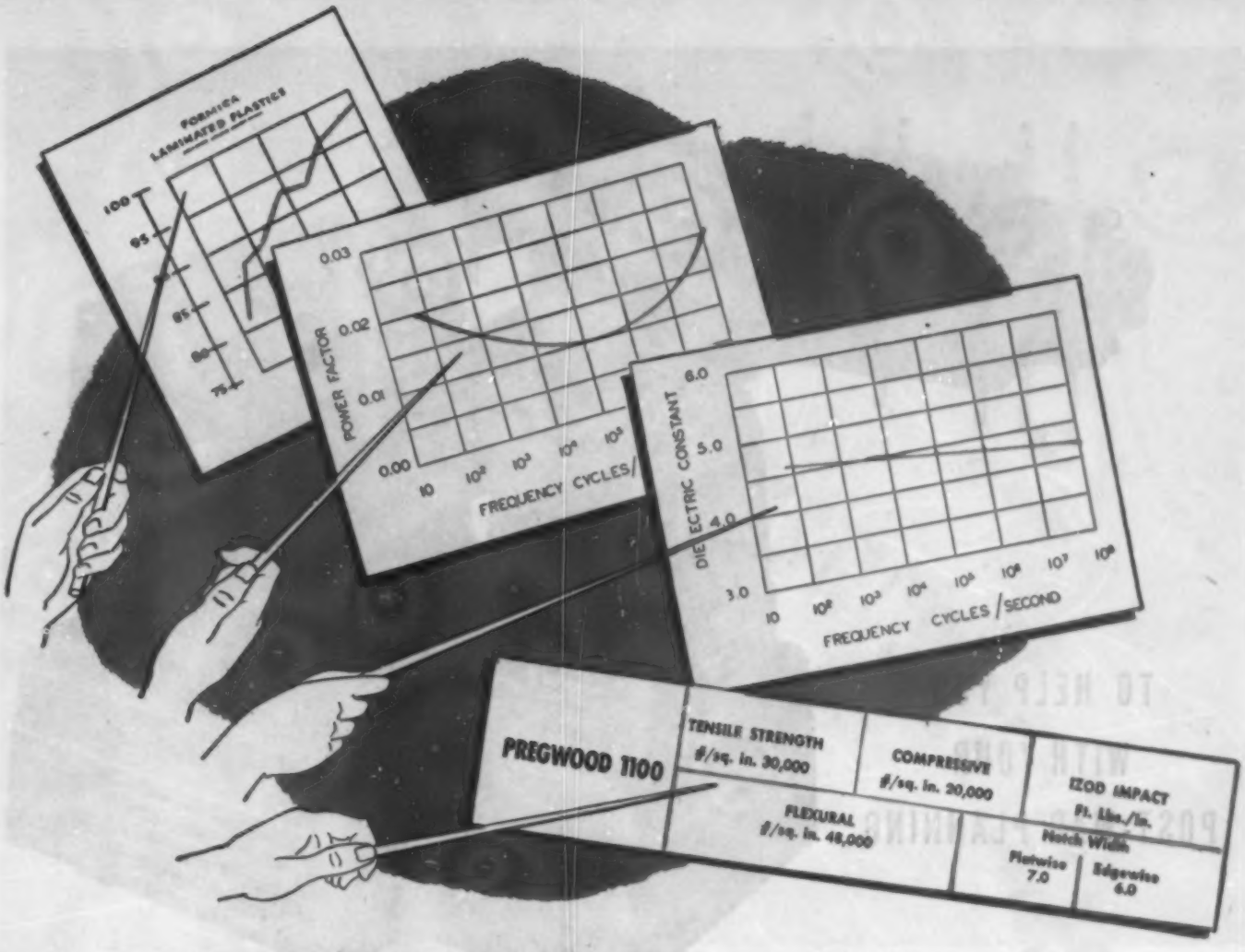


BETTER INFORMATION

on the Qualities of Laminated Plastics!

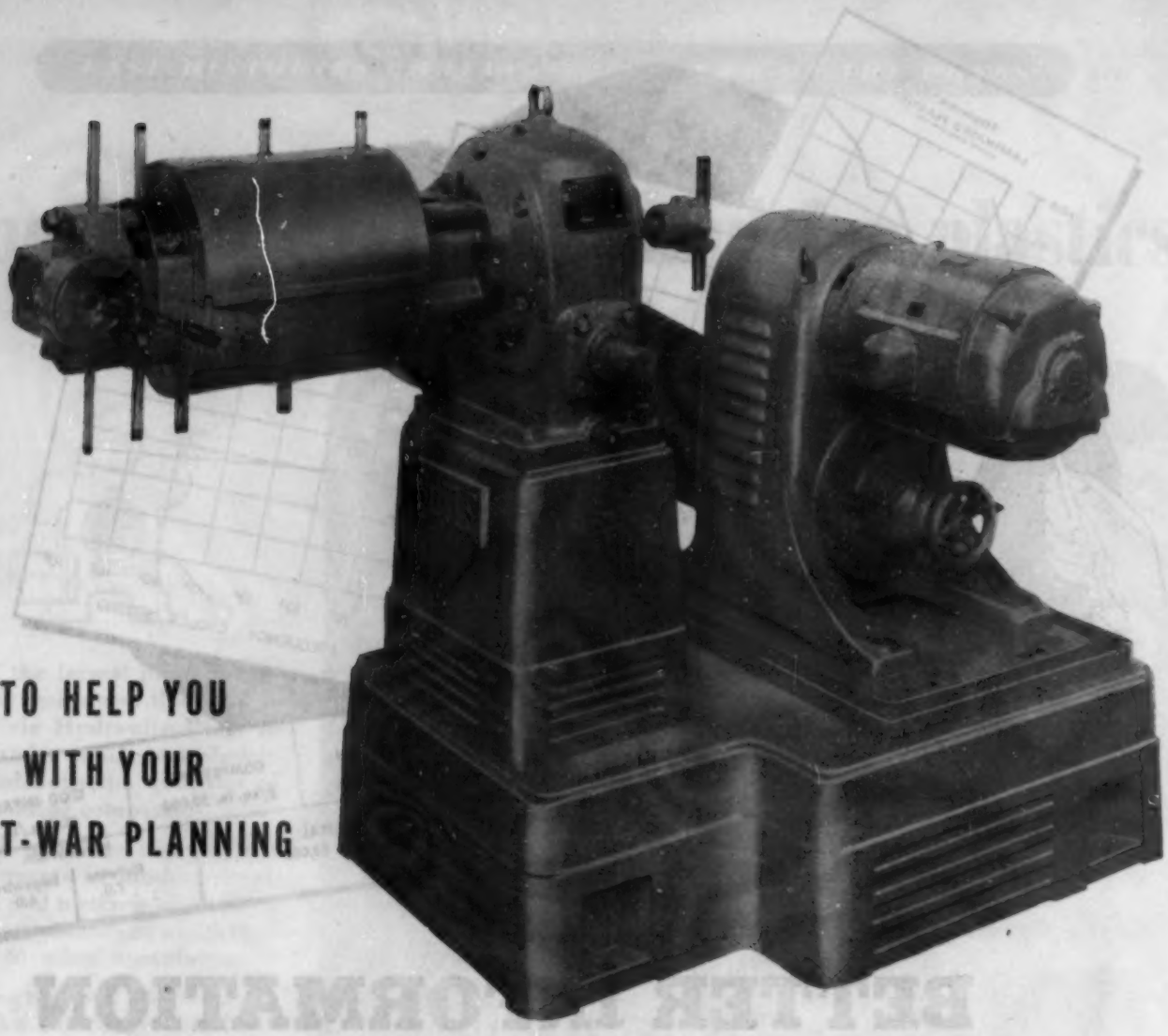
THERE has been a big improvement lately in the variety and quality of the engineering information on the physical and chemical qualities of Formica.

This has been brought about by recent application of the latest testing equipment to Formica's tests in the Formica laboratory, and the enlargement of the engineering staff to make thousands of new tests possible.

After the war you can really get the dope on the grades of Formica you may be considering for your various applications. It will be as complete and thorough as that available for any other material.

FORMICA

THE FORMICA INSULATION CO., 4647 SPRING GROVE AVE., CINCINNATI 32, O.



TO HELP YOU WITH YOUR POST-WAR PLANNING

THE LABORATORY GROUP—fresh from the press—will tell you why the Royal #1½ and the Royal #1 are the extruding machines you will want to know more about when you formulate plans for post-war production and put those plans into operation. In an entirely evolutionary manner features have been built into these extruding machines which will secure successful results with the ever lengthening list of extrudable compounds.

Whether your plans involve research or light product extruding, THE LABORATORY GROUP bulletin gives you the basic data you will require . . . . If you plan a program of research you will find that these extruding machines have the characteristics for heavier product extruding . . . . If you plan light product extruding you will find it more profitable to use an extruding machine specifically designed for such work.

Send for your copy of "THE LABORATORY GROUP" and let it suggest to you how these machines—The Royal #1½ and the Royal #1—can meet your specific requirements.

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Plastics manufacturers are benefiting today from Timken pioneering of many years ago. Take modern machine tools for example; their speed, precision and endurance are largely dependent on the ability of Timken Bearings to eliminate friction, to carry radial, thrust and combined loads and to hold moving parts in correct and constant alignment.

The same qualities will step up the performance of specialized plastics equipment of all kinds including mills and presses. No matter what future developments along this line may be, Timken Bearings will be ready to meet any and all incidental bearing requirements. Make sure your new equipment has them. The Timken Roller Bearing Company, Canton 6, Ohio.

WHY TRANSFER MOLDING PERMITS VARIABLE WALLS

Uniform density, uniform "cure" and freedom from voids are readily achieved by Transfer molding even when they are impossible by compression molding.

Transfer molding, which uses conventional compression-type presses, is generally the easiest, most economical method of molding the phenolics, ureas and melamines. When heavy and thin cross sections are desired in the same piece, Transfer molding is the only completely satisfactory process.

Witness the insulating part, shown in two actual-size views at right, with thin, deep barriers between the various sections. The central barrier is only 1/32" wide and is 5/8" deep.

In producing this part by Transfer molding, the compound was fully and uniformly plasticized in a chamber connecting with the closed mold cavities. The compound entered the mold as a fluid, filling all parts of the cavities and driving entrapped air out of the mold vents. Hence both heavy and thin sections are perfectly homogeneous and the heavy walls are free from voids and undercured sections. After curing, the mold was opened and the completed parts easily removed.

Transfer molding will, indeed, serve you through thick and thin.

SHAW

SHAW INSULATOR COMPANY

160 COIT STREET QUALITY MARK ON MOLDED PLASTICS **IRVINGTON 11, N. J.**

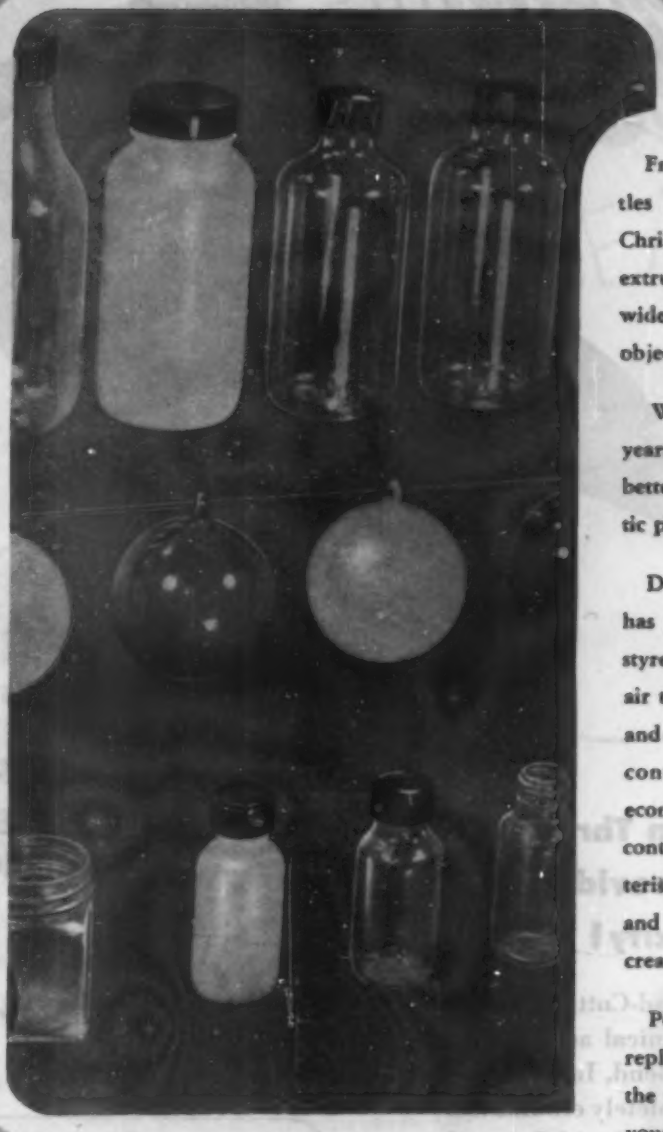
LITERATURE IS AVAILABLE AS FOLLOWS:

A list of nearby licensees who can offer you the advantages of the patented Transfer molding process.

Two bulletins on "Why Transfer Molding Is Economical." Bulletins on "Why Transfer Molding Gives Fine Inserts," "Why Transfer Molding Improves Appearance," and "Why Transfer Molding Permits Better Holes." Also reprints of technical articles by Shaw engineers.

Most plastic processes are used by Shaw and the Plax Corporation, Hartford 5, Conn. Both companies offer unbiased help in plastics applications. For the names of nearby licensed Transfer molders and for literature listed above . . . write Shaw.

COLORFUL PLAX PLASTIC BLOWN PRODUCTS



From crystal clear square polystyrene bottles to brightly colored cellulose acetate Christmas tree balls, the Plax automatic extrusion blowing process is adaptable to a wide range of containers and decorative objects.

With experimental years supplemented by years of actual production and sales, Plax is better able than ever to supply blown plastic products of various kinds.

During the war, as each plastic material has gradually taken its special place, polystyrene bottles have been largely used for air transport of medicines and acids. Weight and space-saving characteristics of plastic containers have proven them to be as economical for air shipments as less costly containers. Their strength and other characteristics, such as the resistance of polystyrene and polyethylene to chemicals, have increased their desirability.

Postwar, such applications as toilet floats, replacing copper, may continue even with the ready availability of metals. We invite your inquiry now.

LITERATURE IS AVAILABLE AS FOLLOWS:

"Extrusion Blowing of Thermoplastics," an illustrated folder.

Several "how to" bulletins on Plax polystyrene products.

Bulletins on Plax cellulose acetate, cellulose acetate butyrate, methacrylate and polyethylene products.

Styramic, polydichlorstyrene, and ethyl cellulose are among the other materials offered by Plax in a wide variety of forms. Engineering help covering nearly all plastic methods and materials is available from Plax and the Shaw Insulator Company, Irvington 11, N. J. For any of the literature listed above . . . write Plax.

PLAX
FOR PLASTICS
NOT SUBSTITUTES···IMPROVEMENTS

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MICROPHONE ASSEMBLY *Simplified!*

SHAKEPROOF
TYPE 25
THREAD-CUTTING SCREWS
SPECIALLY DEVELOPED FOR PLASTICS

Screw Cuts Its Own Thread... Extra Wide Slot Provides Ample Chip Capacity!

Also Available With Phillips Recessed Heads

Shakeproof Type 25 Thread-Cutting Screws have made possible faster and more economical assembly of microphones at Electro-Voice Inc., South Bend, Indiana. Inserts and tapping operations have been completely eliminated. In each microphone, 4 flat head, 3 fillister head and 5 round head Shakeproof Type 25 Thread-Cutting Screws are used. Because the Type 25 remains in the thread it has cut itself, a perfect mating thread is assured, which results in a snug, tight fit. The unique cutting action of the screw provides freedom from dangerous stresses or strains that are likely to cause fractures in molded plastics. An extra wide cavity at the base allows space for chips produced by the cutting edge. Try this modern method of fastening plastics on your own applications.

***Free* TEST KIT**

Get this sample test kit! Contains a variety of styles and sizes of Shakeproof Type 25 Thread-Cutting Screws. Try them on your plastic parts . . . write for Kit No. 10!

SHAKEPROOF inc.
fastening Headquarters

Distributor of Shakeproof Products Manufactured by ILLINOIS TOOL WORKS
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Plants at Chicago and Elgin, Illinois • In Canada: Canada Illinois Tools, Ltd., Toronto, Ontario
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PLASTICS MAKE BEAUTY USEFUL AND UTILITY BEAUTIFUL

Molded plastics serve the engineer and the product designer equally well. For example, a plastic housing that is sleek, colorful and pleasant to the touch, can at the same time provide a weight-saving structural framework . . . plus electrical or heat insulation.

Such a combination of useful functions cannot be achieved with any other material. However, the remarkable properties of plastics can be fully utilized only when guided by a very special kind of knowledge . . . in product design, in mold-making and in production technique. Such specialized knowledge is what we can contribute to your engineering staff for the development of new parts or products. Let us consult with you . . . or send us your specifications for quotations. MOLDED PRODUCTS CORPORATION, 4533 W. Harrison St., Chicago 24, Ill.

PLASTICS DIVISION

MOLDED PRODUCTS

CORPORATION

6 reasons...

WHY THESE FINE PRECIPITATED IRON OXIDE COLORS CAN BE USED SUCCESSFULLY IN **PLASTICS**

1. THEY ARE LIGHT-FAST
2. THEY ARE NON-TOXIC
3. THEY ARE RESISTANT TO ACIDS AND ALKALIS
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5. FINE PARTICLE SIZE
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YELLOWS • REDS • BROWNS • BLACK

MAPICO COLORS

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COLUMBIAN COLLOIDS

Our laboratory staff always is available for technical cooperation

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DISTRIBUTOR

41 EAST 42nd STREET, NEW YORK 17, N. Y.

PEEP-HOLES THAT STAY PUT...

future framework for flashlights or fountain pens, goggles or looking-glasses

The stability and toughness of the cellulosics are well represented in these pocket magnifiers. Molded from cellulose acetate for Testrite Instrument Co. by Boonton Molding Co., they keep glass-metal assemblies permanently secure under any service conditions. Yet they are lighter in weight than former metal frames, more attractive, and cost far less to produce. Injection molding takes but a minute to completely form four single-lens units. Frames and housings, in a wide range of types and sizes, can be made more saleable at lower cost from the cellulosics. Investigate their unique properties *now*.

Rapid production, non-corrodibility, for pencils, pens and flashlights

Lightweight toughness, comfort, for eyeglass and goggle frames

Brilliant color, high luster, for pocket and hand mirrors

For general-purpose production plastics

Hercules does not make plastics or molding powder, but supplies the high-quality cellulose derivatives from which they are made. For data, please write

HERCULES POWDER COMPANY 916 Market Street, Wilmington 99, Delaware.

INCORPORATED

CP-60

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MT. VERNON EXTRA

"Uniform Fabrics for Uniform Permeability"

Dimensional stability and freedom from laminate stratification get a good start in MT. VERNON'S laboratory. Here, MT. VERNON Extra fabrics are checked through every step of production to insure uniform yarn thickness and uniform fabric weave. Thus, by the time a MT. VERNON fabric reaches the laminator, its high uniformity has become a known quantity which permits uniform penetration of resins and uniform production of laminates through each succeeding run. For uniform permeability that means consistently stable products, specify MT. VERNON Extra fabrics.

MT. VERNON WOODBERRY MILLS, INC.

TURNER HALSEY COMPANY

Selling Agents

40 WORTH STREET ★ NEW YORK, N. Y.

CHICAGO · NEW ORLEANS · ATLANTA · BALTIMORE · BOSTON · LOS ANGELES · SAN FRANCISCO

As comparatively new and occasionally untried materials, plastics expose the unwary to numerous pitfalls.

There was a time when with many strategic materials in short supply, a lot of companies rushed pell-mell plasticsward without adequate testing or thought to the future. The password was production at any cost and in some cases the consequences were tragic.

One reason that DETROIT MACOID has avoided making mistakes in plastics extrusions is that we are not afraid to say "NO" when "no" is the only proper answer. One instance that we recall is that of a man who came to us with a well-financed order for many miles of a certain extruded profile. We did a little testing on our own and decided that the materials available were not adequate for the application and we turned the job down. Later, this customer told us that our advice had been sound and that he wished he had taken it.

We cite this example not in an "I told you so" attitude, but to point up the fact that there are times when it is correct not to use extruded plastics. Both our customers and we benefit by this attitude since it prevents us both from making mistakes which might have long-run, harmful repercussions.

But when we say "yes," we mean it. Proof is the dozens of brand new daring applications of extruded plastics we have originated for some of America's leading industries. We work with all fields and we are open for business.

We also do injection molding.

DETROIT
MACOID
CORPORATION
12340 Cloverdale Ave.
Detroit, Michigan

SOCIETY OF THE PLASTICS INDUSTRY · SPI

ORIGINATORS OF
DRY PROCESS PLASTIC EXTRUSION

What would be your Total Time on this Hot Press Die Job?

Courtesy —
Revere Copper & Brass Inc.
Dallas Division

This Hot Press Die, used for hot pressing spigot handles, was completed in a total time of 9 hours on a Milwaukee 2D Rotary Head Milling Machine. Compare this job report with your own methods:

Material — Hot Work Die Steel
Operation — Sink Cavities Complete
Time Distribution — Mill Cavities - 6 hrs.
bore core holes - - - - - - - - 1 hr.
drill ejector pin holes - - - - ½ hr.
mill relief around impression - - 1½ hrs.
Total Time - - - - - - - - - 9 hrs.

Check these advantages of the Milwaukee Rotary Head Milling Machine and how you can benefit from them in your own shop:

DIRECT . . . mills intricate shapes in a single setup without the aid of templets or models — transmitting blueprint dimensions and outlines directly to the workpiece.

ACCURATE . . . chances for error are eliminated because there is no change in setup. Exact control of all combinations of cutting movements — possible only with this machine — transmits mathematical precision to the work.

FAST . . . initial job preparation and setup time are reduced to the minimum. Accurate performance of the machine saves operator's time and results in rapid production of work otherwise difficult to perform.

Write for Bulletin No. 1002C and complete information.

BUILDERS OF MILWAUKEE ROTARY HEAD MILLING MACHINE • MIDGETMILL • SPEEDMILL • FACE MILL GRINDER • AUTOMETRIC JIG BORER • CENTER SCOPE.

Kearney & Trecker
Products
CORPORATION
Milwaukee 14, Wisconsin
Subsidiary of Kearney & Trecker Corporation

Spherical gun turret designed and built by the Engineering and Research Corporation, Riverdale, Md., for the Navy's "Privateer" bomber.

Wartime requirements have been responsible for many new ways of combining materials to get the best results. Some of these combinations will work together to make better peacetime products, too.

Take the case of aluminum and plastics, for example. Here in this spherical gun turret, they work together to give strength, light weight and visibility. They team up to do a good wartime job.

There will be new ways in which aluminum and plastics can work together to make some of those products you are planning more attractive, more useful, more salable. Alcoa engineers will be glad to work with you to help you find the best way to combine them. Write ALUMINUM COMPANY OF AMERICA, 2175 Gulf Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM

If you are looking for plasticizers with

1. LOW TEMPERATURE FLEXIBILITY
2. HIGHEST PLASTICIZING POWER
3. HIGH SOLVENCY *and*
4. WIDE COMPATIBILITY

See HARDESTY CHEMICAL CO.

HARCHEM
PLASTICIZERS
Alkyl Roleates
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For Group Operation of Hydraulically Powered Equipment

PUMPS

Elmes vertical three-plunger pump, Model No. 6293, made in sizes from 3 to 100 h.p. Forged steel body; anti-friction bearings; extra large crank pin; deep stuffing boxes; nitrided plungers; renewable valve seats; stainless alloy valves.

Why does hydraulic pressure as a source of power face such a *rosy future?* Because this irresistible fluid force has had a *remarkable past!*

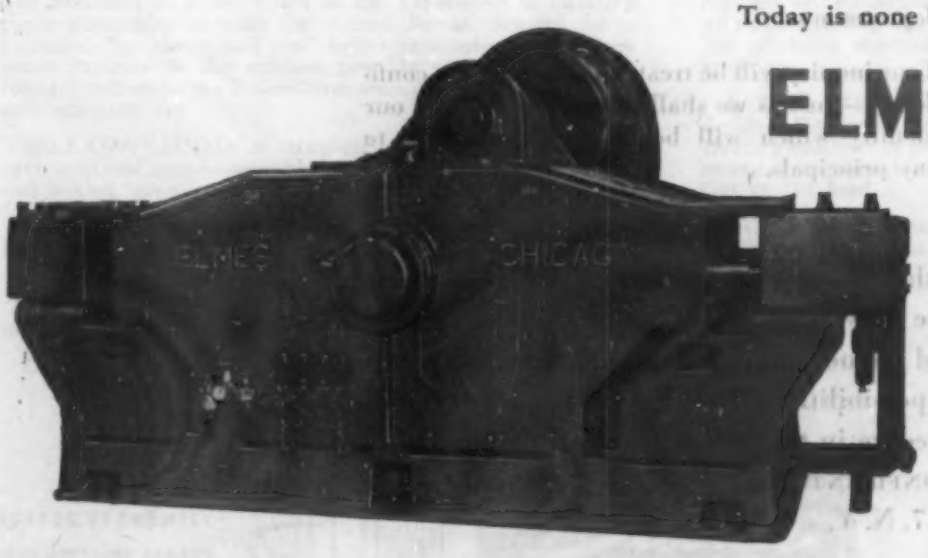
Hydraulic pressure truly performs production *miracles,* and it has kept pace with industrial progress throughout the entire period of America's *phenomenal industrial development.* Elmes hydraulic equipment has served industry for nearly a *century.* The first Elmes high-pressure pumps were made more than *fifty years ago.*

Today's production records would have been impossible without thorough dependability in the units that supply sure fluid power—*the high-pressure pumps.* Pumps, too, have kept pace with progress.

Master of any situation is the Elmes six-plunger pump shown below. Modern Elmes high-pressure pumps cover the *full range* from hand operation to pressures as high as 35,000 p.s.i.

Send for Bulletin 1020—"Elmes High-Pressure Pumps," and ask us to include companion bulletin No. 5100—"Elmes Air-Ballasted Accumulators." Today is none too soon to plan on *cutting costs.*

ELMES HYDRAULIC EQUIPMENT



Elmes horizontal six-plunger pump, Model No. 3935, made in sizes from 150 to 500 h.p. Opposed plungers; heavy, one-piece housing; anti-friction bearings throughout; enclosed herring-bone gears; renewable valve seats; needle-bearing wrist pins; pressure and splash lubrication.

ELMES ENGINEERING WORKS OF AMERICAN STEEL FOUNDRIES, 225 North Morgan St., Chicago 7, Ill.

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METAL-WORKING PRESSES · PLASTIC-MOLDING PRESSES · EXTRUSION PRESSES · PUMPS · ACCUMULATORS · VALVES · ACCESSORIES

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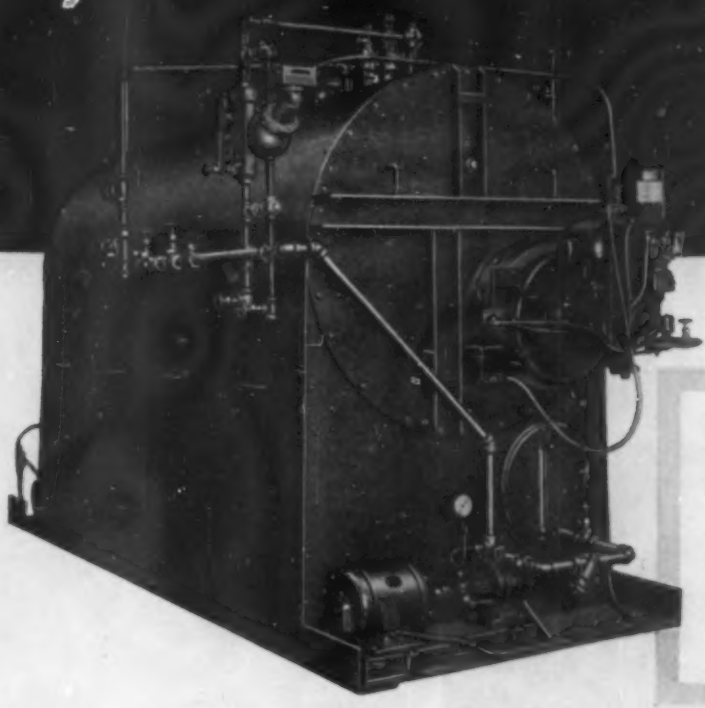
A large company is interested in expanding its present operations in the fields of synthetic resins, rubber, and rubber-like materials for adhesives, coatings and finishes — and also in the field of pressure-sensitive masking tapes and sheetings.

- **It is interested in discussing this problem with any *person* or *persons* or *operating companies* that might fit into this type of picture.**
- **In the case of a company, it is financially capable of paying cash or stock and will give proper contracts of employment, with satisfactory incentive provisions, to operating executives.**
- **In the case of individuals, it has attractive opportunities in its technical, sales and manufacturing departments.**
- **Your inquiry will be treated in the strictest confidence — just as we shall expect you to treat our identity which will be disclosed promptly to any principals.**

We realize that this is a very generalized advertisement, but we mean it to be so. We are assuming that those in whom we would be interested are now ready to put their time against ours in exploring the possibilities of making the results of their efforts to date more secure in the coming competitive markets. Address: STRICTLY CONFIDENTIAL P. O. Box 888, Grand Central Annex, New York 17, N. Y.

Dutton ECONOTHERM
AUTOMATIC STEAM GENERATOR



AUTOMATIC CONTROLS

Less Supervision Greater Efficiency

Includes every instrument and control necessary for fully automatic operation.

The Econotherm is the result of our experience in building steam generators to meet the Armed Forces' demand for a packaged, "set down and run" boiler to develop the greatest steam capacity in the smallest possible space. Some of the features that make the Econotherm outstanding in performance and economy are:

SELF CONTAINED: A complete steam plant in one compact insulated unit — assembled and ready to run. All piping and wiring done at factory. Practically no installation cost.

MULTI-PURPOSE: A versatile unit designed for all industrial, commercial and heating needs from 15 to 150 HP in pressures of 100, 125 and 150 pounds.

FACTORY TESTED: Every unit tested under actual operating conditions before shipped.

COMPLETELY AUTOMATIC: Dutton automatic controls regulate every function including maintaining uniform steam pressure and the normal water level within desired limits. Top efficiency, economy and safety guaranteed with minimum attention.

FASTER STEAM — MORE STEAM: The exclusive Dutton designed Rotary Burner, Induced Draft System and Three Pass Heating combine to give you increased firing rate and quicker steaming to meet maximum steam demands instantly. Either Gas or Oil fired.

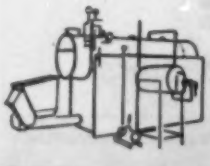
NO CHIMNEY: Smokeless because gases are scavenged — small pipe carries flue gases outside boiler room.

SAVES SPACE: Extremely compact. Twice the power in half the usual space.

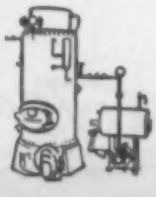
CLEANER: Dutton combustion principles produce perfectly clean operation. No messy, cluttered up boiler room.

WRITE FOR FULL INFORMATION

DUTTON ECONOMIST HIGH PRESSURE BOILERS



Dutton



DUTTON AUTOMATIC VERTICAL BOILERS

PRESSURE VESSELS • HEAT EXCHANGERS • CONDENSERS

THE C. H. DUTTON COMPANY • 618 GIBSON STREET • KALAMAZOO, MICHIGAN

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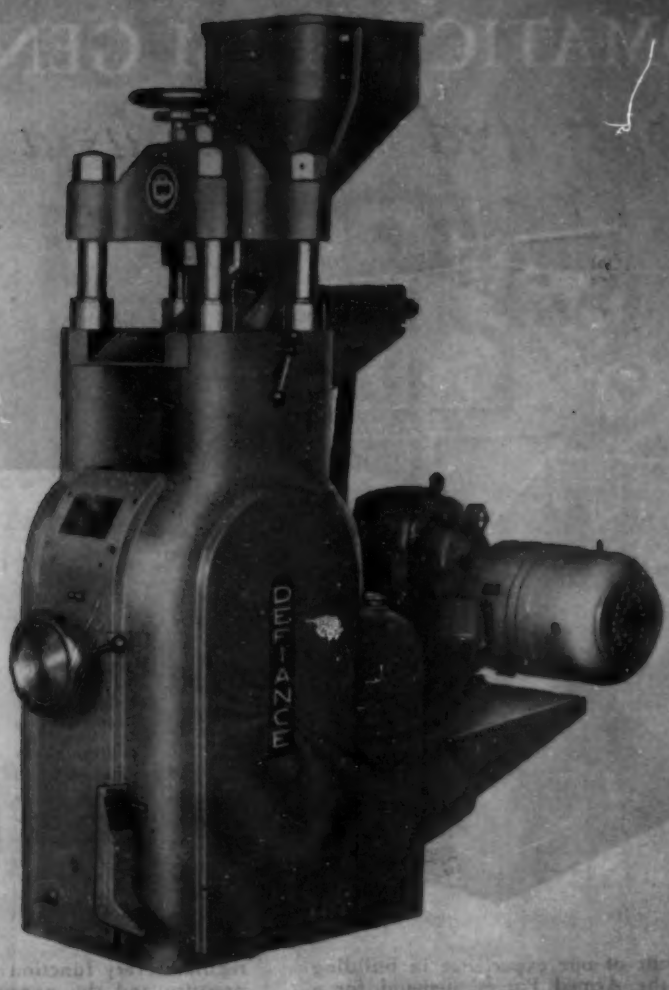

● Defiance Plastic Preforming Machines are designed to produce tablets at high speed in wide variety of shapes and sizes. Weights of preforms can be rapidly changed—without stopping the machines. Write—

Defiance Machine Works, Inc., Defiance, Ohio.

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Plastic Preforming Presses

BUILDERS OF PRECISION MACHINERY SINCE 1850

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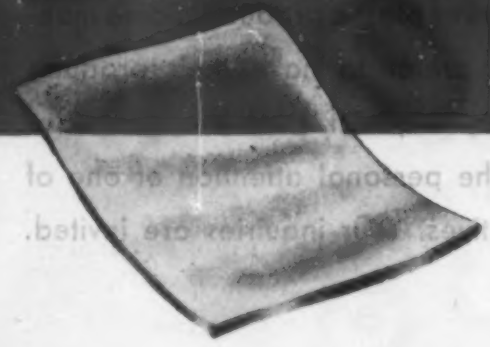

FORMALDEHYDE

37% U. S. P. Solution. Uniform in strength and high in purity. Low acid and metals content. Available in quantities to meet individual requirements — from tank cars of 72,000 lbs. to bottles of 1, 3 and 9 lbs.

PARAFORMALDEHYDE

Packaged in 100 pound fiber drums or wooden barrels. Powdered or granular types are available.

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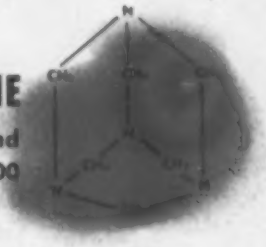
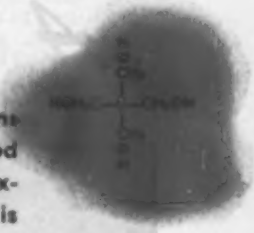


Technical and U. S. P. Crystals and powder available. Packaged in 200 pound barrels.

PENTEK*

(Pentaerythritol, Technical)



Used in alkyd resins, synthetic resins and coating compositions where good water resistance, rapid bodying, excellent durability and rapid drying is needed.

M. D. A.

(Methylene Disalicylic Acid, Technical)

Combines the reactive carboxylic acid groups with the phenolic groups in the same molecule, making it possible to combine the versatility of the alkyd type resins with the chemical resistance of the phenolic type. M. D. A. may be used to produce modified phenolic resins which can be cooked into varnishes by the usual methods to produce fast-drying paints and varnishes of improved chemical resistance.

Samples, technical data sheets and further information available upon request.

**Trade Mark Reg. U. S. Pat. Off.*

HEYDEN Chemical Corporation

393 SEVENTH AVENUE, NEW YORK 1, N. Y.

A Matter of Craftsmanship

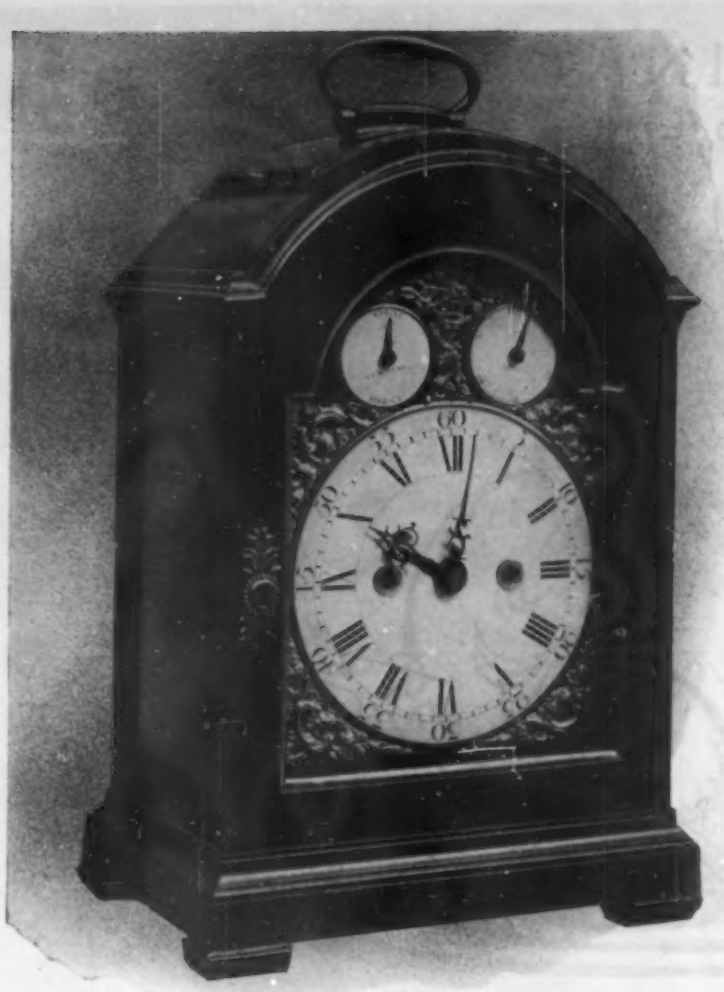
This automatic pistol, injection molded by Pyro, looks like the real thing.

These plastic coat hooks are injection molded in one piece in attractive colors.

We deal in plastic products and not in precious stones . . . but we have the same feeling for an accurately molded plastic part that an expert lapidarist has for a perfectly cut diamond or emerald. Here at Pyro we specialize in serving a limited number of users of plastic products. Some manufacturers prefer to have their products molded by a plant where each order receives the personal attention of one of the executives. Your inquiries are invited.

For fine workmanship specify **Pyro** *molded plastics*

THE PYRO PLASTICS COMPANY • WESTFIELD • NEW JERSEY



Consistency in Running

This celebrated clock has been running for over 150 years. Made by Alexander Cummings of London. Circa 1790. From the famous Wetherfield Collection of English clocks on display at the galleries of Arthur S. Vernay, N. Y. C.

Consistent performance makes an antique clock valuable. And consistency is just as essential in a plastic. Molders have learned to depend on the fine running qualities of Chemaco molding powders. From drum to drum, there is a clock-like regularity in color, formula, running qualities and results.

Chemaco plastics will meet your most exacting specifications, whether they call for cellulose acetate, ethyl cellulose, vinyls or polystyrene.

Chemaco engineers are ready to offer assistance in the selection of the correct material and formula.

Chemaco Corporation

A subsidiary of Manufacturers Chemical Corporation

Berkeley Heights, N. J.

Branch Office—Cleveland, Ohio

"PINKO"
DRINKS LIKE A FISH!

HOPEWELL KRAFT PINKO

Hummel-Ross "Pinko" Paper is highly absorbent. Frankly, it drinks like a fish. And this remarkable quality is making it tremendously interesting to the Plastic Industry. Your own laboratories will want to experiment with "Pinko" for plastic impregnation and in making plastic laminates.

ASK FOR SAMPLES

An inquiry addressed to our Plastics Research Laboratories will bring you samples in various calipers and absorbencies. Specific data will also be furnished you gladly.

Originators • Creators

HUMMEL-ROSS FIBRE CORPORATION

Hopewell, Virginia, U. S. A.

The most revolutionary advance in modern oil-hydraulics

MULTIPRESS with VIBRATORY HydrOILic PRESSURE

FAST APPROACH PORTION OF STROKE (FIXED SPEED)
REGULATIVE PRESSING SPEED PORTION OF STROKE (20 to 200 ipm)
MANUAL OR FULLY AUTOMATIC RAM CYCLING
EACH REPEAT STROKE EXERTS EXACT PRE-SET PRESSURE
LENGTH OF REPEAT STROKES REGULATIVE .004 to 1/2-inch
NUMBER OF REPEAT STROKES REGULATIVE 1 to 25, automatically 1 to infinity, manually
FREQUENCY OF REPEAT STROKES REGULATIVE
RAM FOLLOWS WORK AS IT YIELDS, EXERTING EXACT PRESSURE
MULTIPRESS
TIME

Vibratory HydrOILic Pressure — just *one* of many unique control features available with the amazing new MULTIPRESS — imparts any pre-set number of short, rapidly-repeated, exact-pressure strokes *upon each full downstroke of the ram!*

As shown above, these repeat strokes are regulative in length, pressure, speed, frequency, and number per ram cycle. And the ram *follows the work* downward as it yields, exerting exact pre-set pressure on each vibratory stroke.

MULTIPRESS — a completely self-contained, motor-driven, oil-hydraulic bench press, in 4 and 6-ton sizes — makes this *exactly controlled* vibratory action available at surprisingly low cost. Other MULTIPRESS accessories include automatic cycling controls, straightening fixtures, reciprocating tables, pelleting devices, automatic indexing tables, foil feeds, a variety of bolster plates, benches, extension tables, side shelves — to mention only a few. Write today for further information. The Denison Engineering Co., 1176 Dublin Rd., Columbus 16, O.

DENISON
EQUIPMENT for APPLIED
HydrOILics

HydrOILics
INDUSTRY'S RIGHT HAND

TROUBLE CHASER!

Even though carefully hand driven, and then smoothed up, slotted screws spelled trouble for this well-known typist's chair manufacturer. Some burrs got by inspectors, snagged steno's stockings.

OUTPUT PACER!

But burrs became a memory when he switched to Phillips Recessed Head Screws. Better still, workers, freed of the dangers of finish-scarring driver skids, boosted output plenty with fast power-driving.

FUTURE FACER!

Because they are engineered to take top driving pressures, Phillips Screws help designers improve product strength and rigidity. With stronger, tighter fastenings, any product is in better shape to meet coming competition.

ORDER PLACER!

At the point-of-sale, the Phillips Recess' eye-appeal will help to get the order. Burr-free, blending with any product's beauty – it's the finishing touch that softens the toughest prospects!

It's Phillips ... the engineered recess!

In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

... It's the exact pitch of the angles that eliminates driver skids.

... It's the engineered design of the 16 planes that makes it easy to apply full turning power – without reaming.

... It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50% – cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

Made in all sizes, types and head styles

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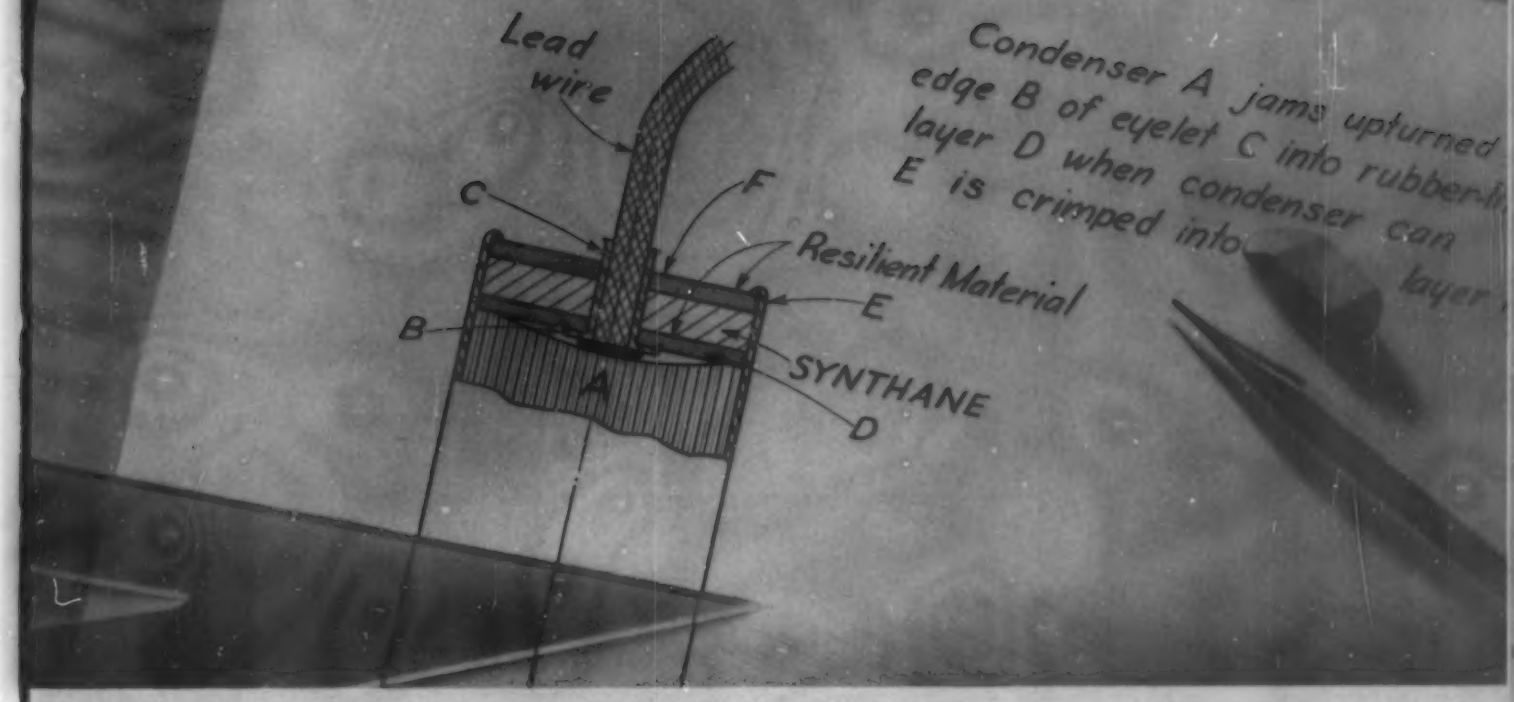
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
The Steel Company of Canada Ltd., Hamilton, Canada
Wolverine Bolt Co., Detroit, Mich.

PLASTICS where PLASTICS belong



Using Mechanical and Dielectric Strength

SYNTHANE laminated phenolic, sandwiched between and bonded to layers of a resilient material, is the basis of an interesting plastics application.

The assembly—a condenser—depends upon the resilient material for a perfect seal when the edge of the can is crimped. Synthane backs up the resilient material, provides needed strength and rigidity, and is also an excellent electrical insulator, unaffected by condenser oil.

In an application such as this, as in many others, it is desirable to consult our engineers before you design to see if Synthane can be used, and to decide which grade of Synthane will best meet your individual requirements and can be easily and readily produced. In fact, we will work with you from design, through selection of material, down to the delivery of the finished plastics parts, relieving you completely from worry and responsibility. Synthane Fabricated Parts are produced by men who know how to make plastics and how to machine them, using specialized equipment. Synthane Corporation, Oaks, Pennsylvania.

SYNTHANE TECHNICAL PLASTICS DESIGN • MATERIALS • FABRICATION

SYNTHANE

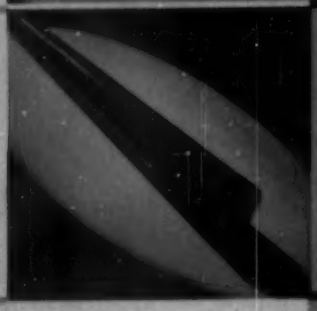
How many of these forms of Synthane do you recognize . . . and use?

1 SYNTHANE SHEETS
Made by curing layers or laminations of impregnated paper or fabric with heat and high pressure.

2 SYNTHANE WRAPPED TUBES
Made by curing impregnated paper or fabric, wound about a mandrel, with heat.

3 SYNTHANE MOLDED TUBES
Same as wrapped tubes except tubes are cured under heat and pressure in molds.

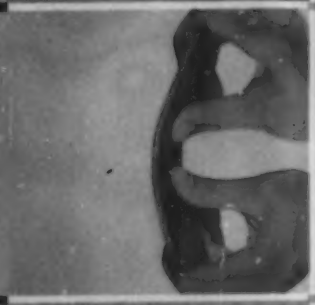
4 SYNTHANE RODS
Produced by a method similar to that used in processing molded tubes.



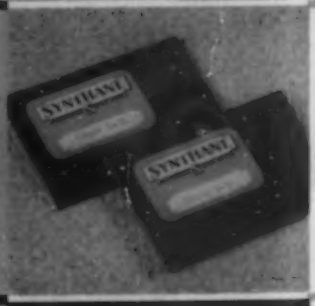
5 SYNTHANE MOLDED-LAMINATED
A means of producing parts in a finished or nearly finished form by curing layers of sheets under heat and pressure in molds. An economical way of making parts in quantity, retaining the desirable strength characteristics of Synthane sheet material.

6 SYNTHANE MOLDED-MACERATED
Flakes of impregnated fabric are cured under heat and pressure in molds. More intricate parts can be formed than are possible by molded-laminated. Strength surpasses ordinary powder molding, does not equal molded-laminated.

7 COMBINATION MOLDED-LAMINATED, MOLDED-MACERATED Some parts requiring strength in certain sections but intricacy in others may be made by a combination of the molded-laminated, molded-macerated methods.



8 COMBINATION MATERIALS
Synthane is sometimes bonded under pressure to other materials to achieve a combination of properties not obtainable any other way. The resiliency of rubber or Neoprene is often teamed with the strength and insulating characteristics of Synthane.



9 SPECIAL MATERIALS
Synthane is available in special forms such as this graphited anti-friction Synthane. The inclusion of graphite is desirable on some applications.

10 FABRICATED PARTS
Synthane produces finished parts by machining sheets, rods, tubes or by molded-laminated or molded-macerated processes or by combining machining and molding operations.

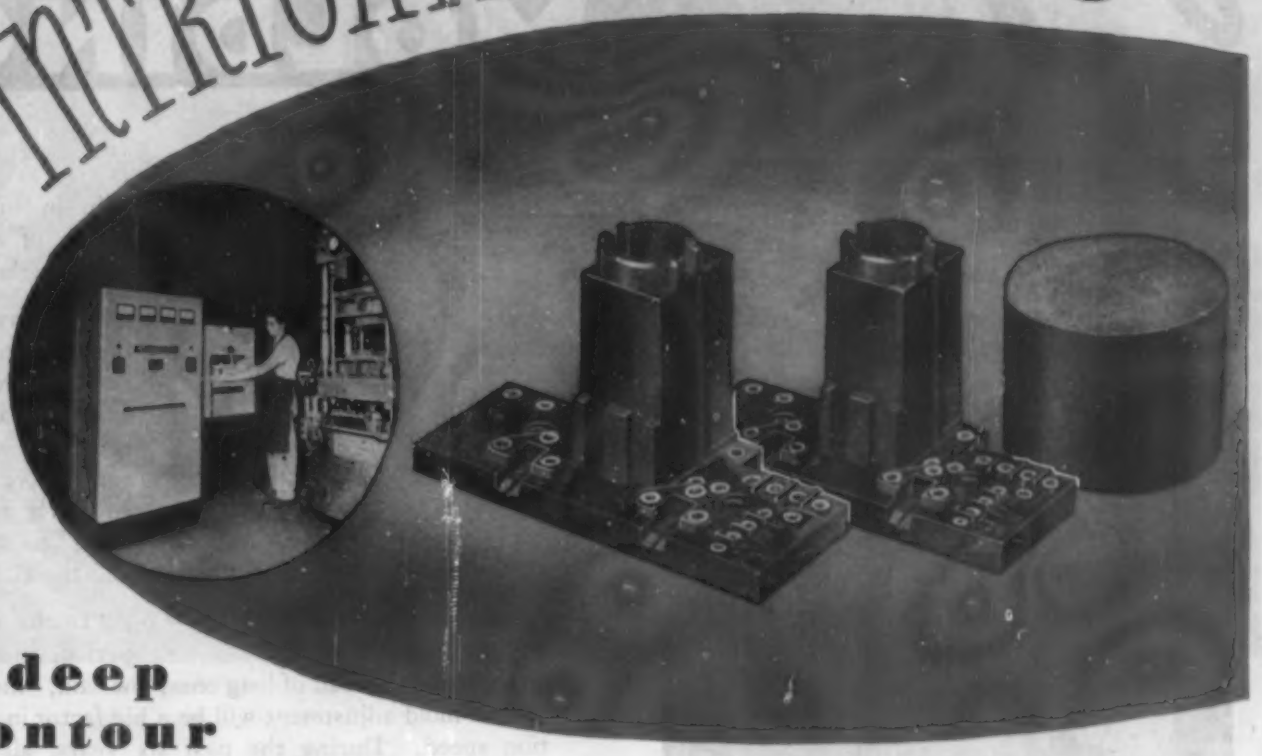
SYNTHANE CORPORATION, OAKS, PENNA.

SYNTHANE

Representatives in All Principal Cities

PLAN YOUR PRESENT AND FUTURE PRODUCTS WITH SYNTHANE TECHNICAL PLASTICS · SHEETS · RODS · TUBES · FABRICATED PARTS · MOLDED-LAMINATED · MOLDED-MACERATED

INTRICATE LOW PRESSURE MOLDING



• • •

a deep contour mold

21 *inserts—with* MEGATHERM*

Here again Megatherm high-speed through-heating of plastic preforms provided the solution to a knotty production problem.

Ordinary methods of preform heating . . . plus molding pressures up to 120 tons . . . resulted in high rejection ratios in this part because of its irregular wall-thickness, deep-draw, and 21 metal inserts.

Free-flow conditions produced in the mold by Megatherm uniform heating reduced rejects to a minimum . . . producing parts with a high gloss finish free from flash . . . and the metal inserts were clean and bright.

At the same time . . . molding pressure was reduced to *12 tons.*

More and more alert molders are recognizing MEGATHERM as indispensable to high-speed quantity production of normally difficult and costly parts on a sound commercial basis.

When MEGATHERM *goes in . . . production volume goes up . . . and stays up!*

Write now . . . on your company letterhead for complete data on MEGATHERM engineered dielectric heat.

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Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

*Reg. U.S. Pat. Off.

Injection MOLDING

NUMBER EIGHT OF A SERIES

Great Britain's largest injection molding company operates Great Britain's largest injection molding machine, a 16-ounce Lester which has been running 140 hours per week with less than 10 percent down time since its installation more than a year ago. The same firm, Injection Moulders Ltd., of Queensbury, London, owns four other Lesters, all of which have established similar production records since 1939.

The 16-ounce machine is shown here in Plant No. 1 at Queensbury, molding the patented David non-spill vent plug which is used on every airplane and tank battery made in England for military use. The plug is made of glass-clear polystyrene, and each of its four parts is molded in multicavity molds.

All of the Lester machines operated by Injection Moulders Ltd., are operated by women—young, middle aged and old—with uniformly good results. Lester simplicity of design and ease of operation have made injection molding possible with similarly unskilled help in numerous plants of war-ravaged England.

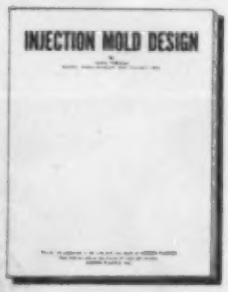
A. E. Davey, vice president of Injection Moulders Ltd., believes that Lester efficiency will be even more apparent after the war, and plans to install additional Lesters.

"In the postwar period, when we are on short runs instead of long ones," he said, "the Lester central mold adjustment will be a big factor in production speed. During the past six years, all of the patented Lester features* have helped us to make better moldings at higher speed and lower cost."

Are *you* familiar with the advantages offered by Lester machines? If not, we shall be glad to supply you with any data you need.

**Central mold adjustment, double-toggle mold locking mechanism, automatic oiling of toggle cams, beam-type alloy steel frame, interchangeable hollow injection cylinder, independent pressure and volume control of injection.*

Injection Mold Design



Islyn Thomas, New York plastics consultant, has written two clear and authoritative articles on the subject of injection mold design, planned to bring together the plastics customer, the sales engineer and the mold designer so that they may reach a better understanding of one another's problems. As a service to the industry we have reprinted these and offer them free to the readers of this magazine. Send for your copy today.

INJECTION MOLDING MACHINES

"Shaping the Things of Tomorrow"

National Distributors:

LESTER-PHOENIX, INC., 2711 Church Ave., Cleveland 13, Ohio

AT NORTHWEST *Plastics*

WE'RE LOOKING AHEAD!

Our special transfer molds of three to twelve cavities which are used with special transfer presses are designed to provide a method for maintaining molding pressure on the piece while the mold is removed from the press, and curing is completed in an oven. This technique, in rubber molding for example, permits a press to handle twenty molds per hour as against two molds per hour with conventional methods. The same cure time will be maintained on each mold, but this one press is now doing the work of ten.

The method provides an opportunity to reduce unit costs substantially on small quantity orders without involving the higher costs of large multiple cavity molds.

This technique further provides a method for sharply reducing the amount of flash cleaning usually required. With this method close tolerances are easily held and the quality of the molded pieces maintained at a consistently high level.

Our services are at your disposal to assist you with your molding problems. Write us today for complete information. Northwest Plastics Incorporated, 2233 University Ave., St. Paul 4, Minn.

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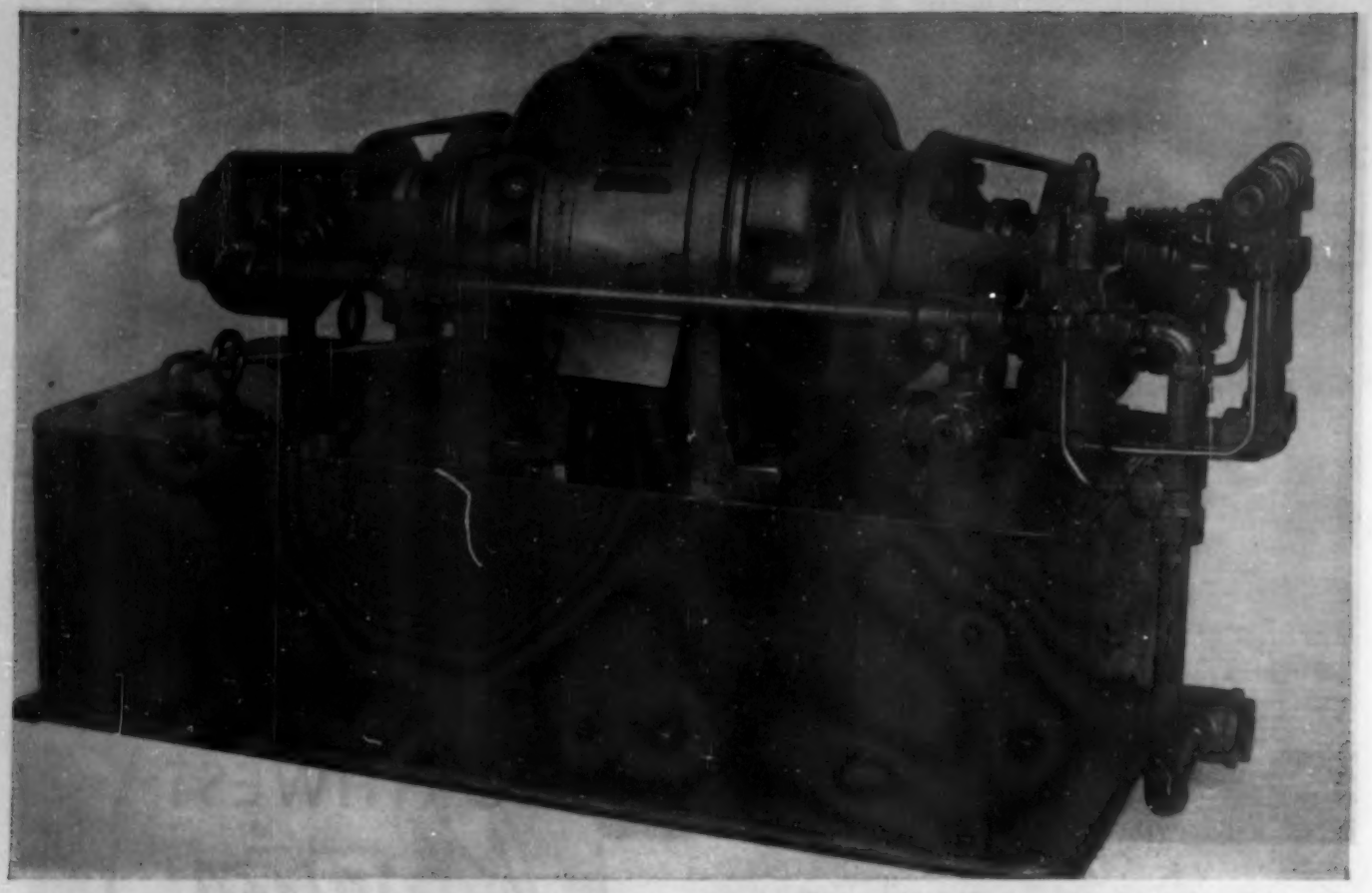
NORTHWEST PLASTICS inc.



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Packaged Assemblies Combining High Pressure Low Volume and Low Pressure High Volume Pumps and Valves for Manual and Automatic Control

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BROACHES • PRESSURE SEALS • FLOW TESTS • BEARING FLOTATION

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21 GPM • 3000 P.S.I.

These units have been in extended service in Rolling Mills • Textile Plants • Chemical Plants • Plastic Plants • Testing Laboratories • Research Laboratories • Rubber Plants • Powdered Metal Industry • Aviation Research • Airplane Manufacture for Standard Equipment and Production Test Procedure

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for dependable plastic fabricating

Plastic fabrication calls for "know-how," experience and dependability. **Dura** gives you all this through its skilled staff and completely equipped plant, now serving vital war needs. With a background of performance in production of precision parts for landing craft, planes and instruments, **dura** is prepared to meet the new requirements of production for civilian needs. Interested firms, looking ahead to postwar opportunities, are invited to discuss their projects involving plastic fabrication with us.

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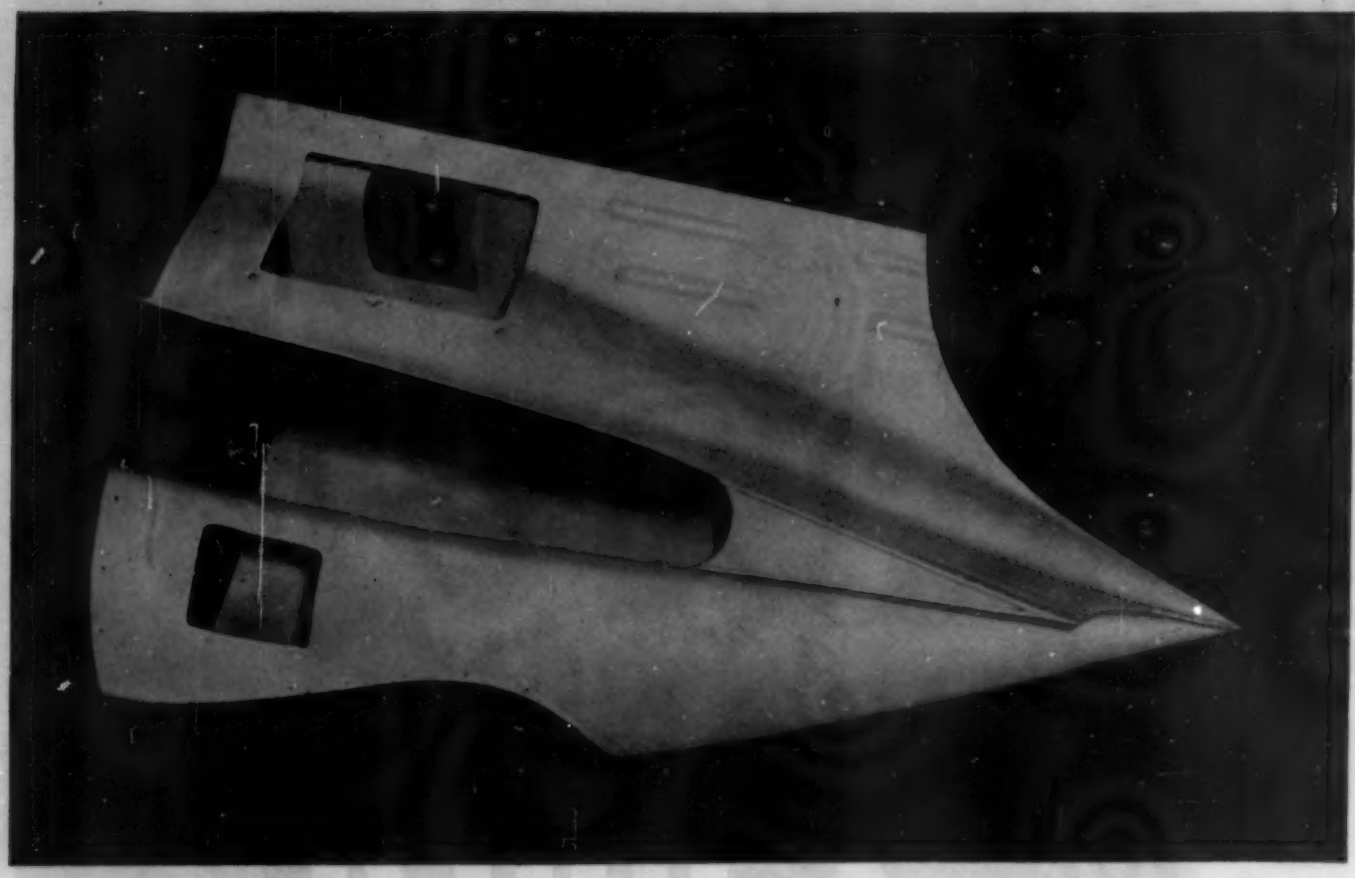
Custom fabricating specialists to the aviation, electronic and shipbuilding industries.



IT IS DIMENSIONALLY STABLE...

another Fiberglas*-reinforced plastics plus value

The test tail section of the BT-15 trainer plane, shown above, illustrates several of the many commercially significant properties of Fiberglas-reinforced plastics.

Used with several types of low-pressure resins, Fiberglas Cloth (made of fine fibers of glass, twisted into yarn and woven) provides an entirely new and different type of product—*with a combination of characteristics found in no other material.*

Structural sections, such as illustrated above, are dimensionally stable because moisture does not swell or shrink the glass fibers used for reinforcing. They have extremely high impact strength and are light in weight. Fabrication is fast, easy and economical. Expensive dies and heavy fabricating equipment are not required. Large sections can be made in one piece, thus reducing handling and finishing time, minimizing assembly costs.

These outstanding advantages may have an important bearing on the product you are making now or on those which you will use or produce in the future. Why not get complete facts about Fiberglas-reinforced plastics now? Write: *Owens-Corning Fiberglas Corporation, 1876 Nicholas Building, Toledo 1, Ohio.*

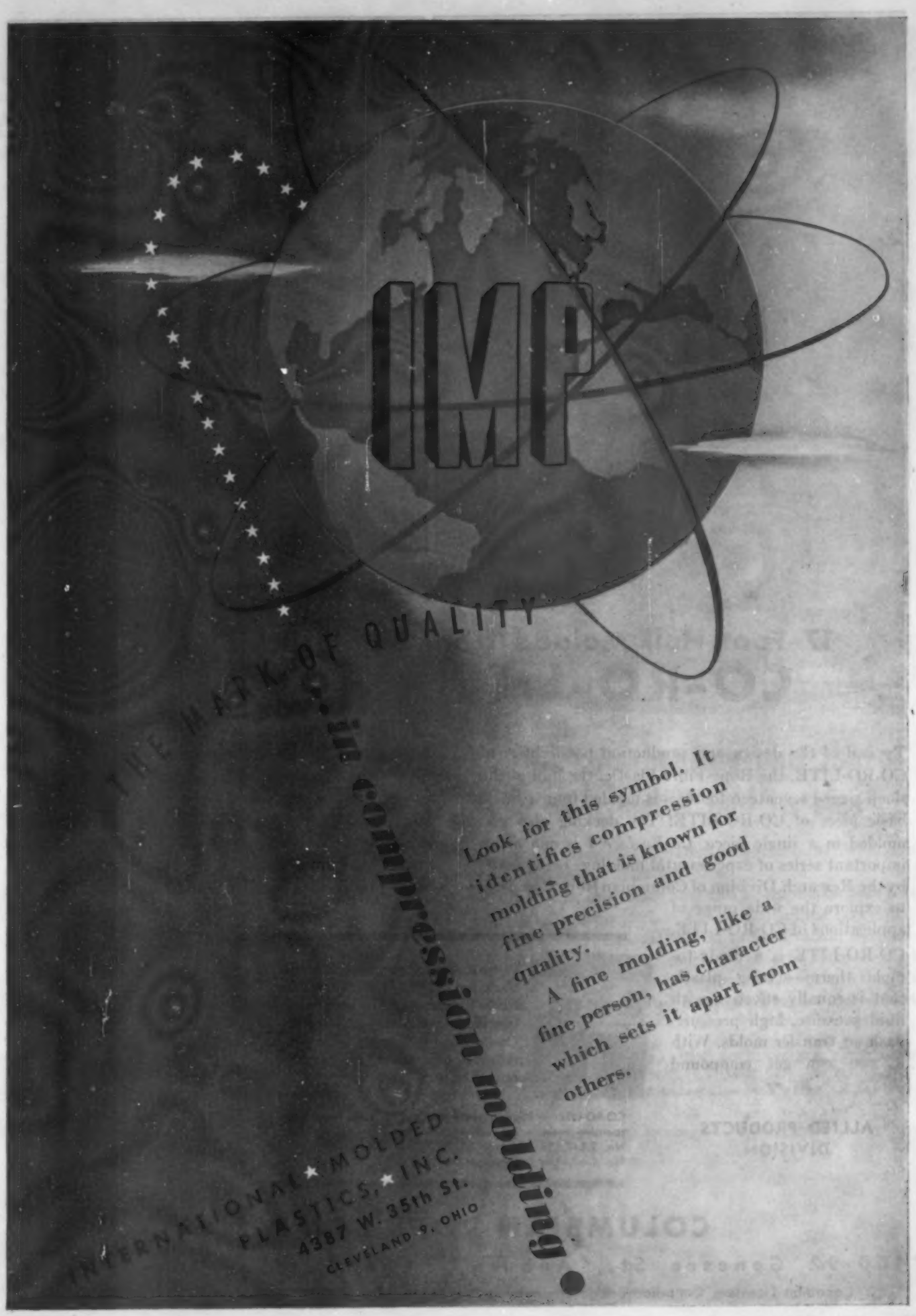
In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.

Owens-Corning Fiberglas Corporation does not manufacture resins or finished laminates but will be glad to supply experimental samples of Fiberglas Cloth and data on techniques in its use with plastics.

ARMY E NAVY

FIBERGLAS.. *A BASIC MATERIAL*

*T. M. Reg. U. S. Pat. Off.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INTERNATIONAL MOLDED PLASTICS, INC.
4387 W. 35th St.
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in compression molding
Look for this symbol. It identifies compression molding that is known for fine precision and good quality.
A fine molding, like a fine person, has character which sets it apart from others.

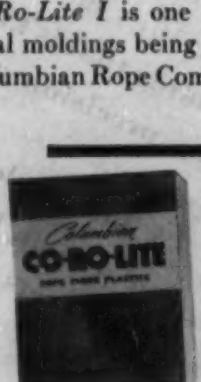
Co-Ro-Lite I
17 foot sloop, built by Columbian Rope Company from plans by Sparkman and Stephens, Inc.

17-Foot Hull Molded from Single Basic Piece of CO-RO-LITE, *the Rope-Fibre Plastic*

Typical of the design and production possibilities of CO-RO-LITE, the Rope-Fibre Plastic, the hull of the sloop-rigged seventeen-footer was molded from a single basic piece of CO-RO-LITE! The decking also was molded in a single piece. *Co-Ro-Lite I* is one of an important series of experimental moldings being made by the Research Division of Columbian Rope Company to explore the wide range of applications of CO-RO-LITE.

CO-RO-LITE is a ready-to-mold thermo-setting plastic that is equally effective with fluid pressure, high pressure, flash, or transfer molds. With it you can get compound curves, deep draws, angles, channels and large shells with marked economy in preparation, lay-up, and curing time.

Its remarkable strength makes possible the ribless construction of the hull of *Co-Ro-Lite I*, while its ability to form complex curves enabled Olin J. Stephens, its designer, free use of almost any form desired without restrictions as to shape imposed by conventional materials. Indicative of the future is the already established fact that four men, working with two molds, can produce two hulls an hour —ready for fitting!



Write today for our newest handbook on CO-RO-LITE, the Rope-Fibre Plastic — and ask for any specific information you'd like on *Co-Ro-Lite I* — flagship of a significant new fleet of plastic-hulled boats.

CO-RO-LITE: — Rope fibres impregnated with thermo-responsive resin: — Product and process patented—Patents No. 2,249,888 and No. 2,372,433 — other patents pending. Co-Ro-Lite Boat patent No. 2,376,753.

ALLIED PRODUCTS DIVISION

COLUMBIAN ROPE COMPANY

460-92 Genesee St., Auburn, "The Cordage City", N. Y.

Canadian Licensee: Canadian Bridge Engineering Company, Ltd., Box 157, Walkerville, Ontario, Canada

For the BIG jobs—a high frequency plastics heating unit that's as convenient and practical to use as a model half its size

Meet a brand new member of the most complete line of high frequency heating units for the plastics industry—the biggest self-contained model on wheels in the field, capable of raising 7 pounds of average material 170 degrees in one minute.

Compact for its size, it rolls—easy to install, easy to move around, easy to fit into your molding set-up. Operating it is a matter of sheer simplicity, easy as closing and opening a drawer. The material is heated in a built-in compartment, on a removable electrode tray. The high frequency energy (signalled by red light) automatically turns on when the tray is closed, automatically turns off (signalled by green light) when the required temperature is reached.

Now high frequency heat can be applied where it is potentially most useful—in the heating of large preforms, which are least subject to penetration by ordinary surface heat and therefore most subject to hard centers. High frequency energy not only does the job quickly but uniformly, throughout every cubic inch of material.

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150 Broadway, New York 7, N. Y. *228 N. La Salle St., Chicago 1, Ill.*
1836 Euclid Avenue, Cleveland 15, Ohio

The First
INDUSTRIAL HIGH FREQUENCY
DIELECTRIC HEATING EQUIPMENT

The Girdler Corporation, Dept. MP-8, Louisville 1, Ky.

Please send complete information and specifications about Thermex Model 185X.

Name .....

Firm Name & Address .....

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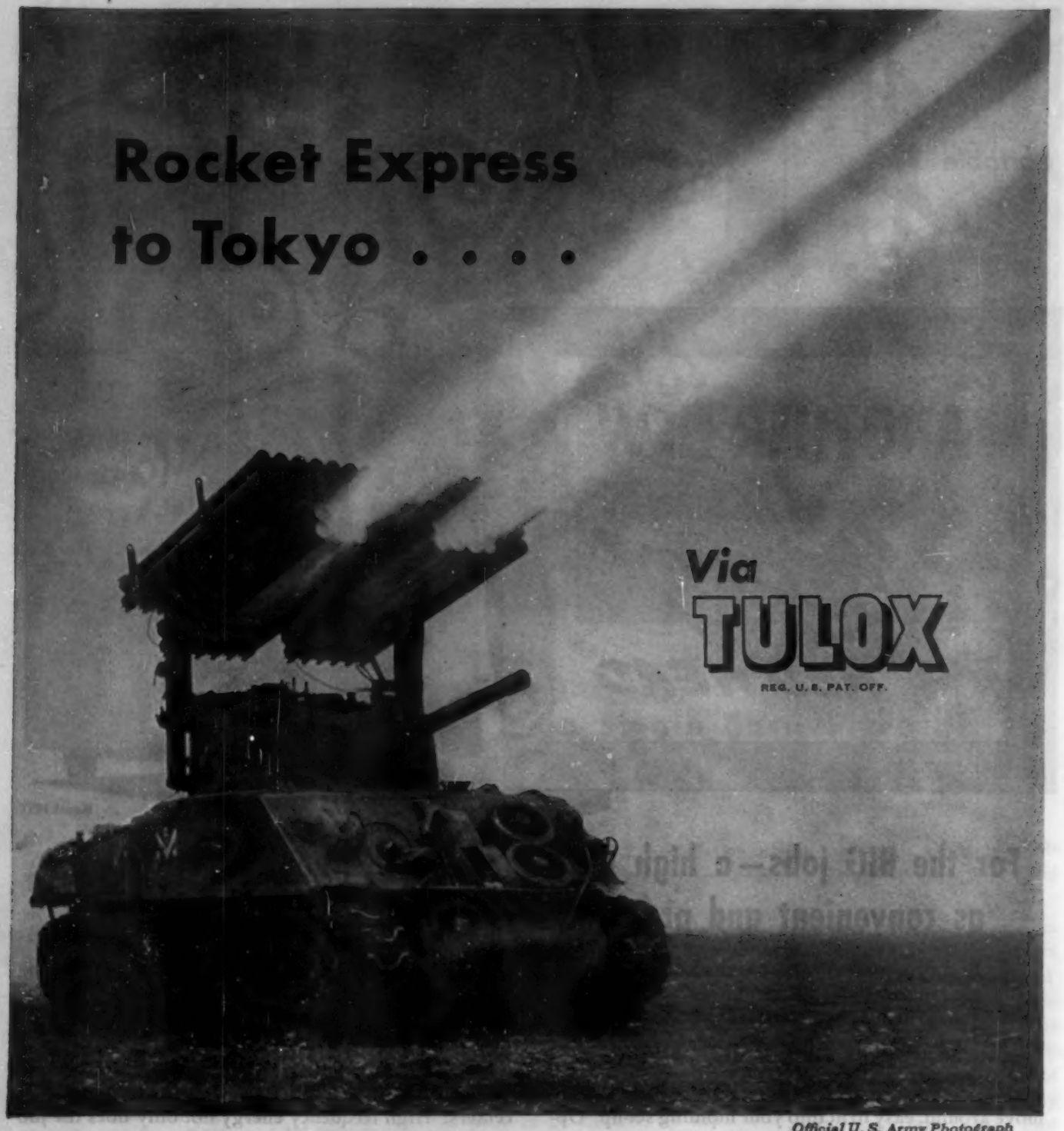

Official U. S. Army Photograph

This U. S. Army tank equipped with the T34 Rocket Launcher has terrific firing power.

Extruded Plastics, Inc., have collaborated with the General Electric Company in the supply of TULOX EC Igniter Tubes for this type rocket. And these tubes are headed for the Pacific by the million!

TULOX extruded plastic tubing fills many needs of our fighting forces—just as it will fill many needs of general industry.

A first quality product made to fine tolerance, TULOX tubing is now available for war end-use only. A full size-range from ⅛" O.D. to 2" O.D. for immediate delivery from warehouse stock. Samples are available for experimental postwar development work.

May we send you our latest data sheet and photo folder of other TULOX end-uses?

Extruded Plastics, Inc.

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IN CANADA: DUPLATE CANADA, LTD., PLASTIC DIVISION, OSHAWA, ONTARIO

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MOSINEE is one of the "proved-in-service" materials emphasizing great technological strides in product engineering. MOSINEE is "marching home again" with a creditable "service record" in fields of duty that formerly were unexplored.

The "paperologists" of The Mills of Mosinee are fortified by broad experience, plus the finest of laboratory and production facilities. Cooperation of Mosinee engineers with manufacturers in many lines has resulted in improving product-quality, expanding product-utility, lowering production costs . . . thus helping to open new opportunities, new markets.

A conference with Mosinee "paperologists" might disclose similar opportunities for you. Mosinee is ready.

Please address your letter "Attention Dept. A"

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EASILY HOBBED STEELS THAT ASSURE CLEAN, UNIFORM MOLDS

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DISSTON

PLASTALLOY

More and more manufacturers of plastic products are finding Disston Plastiron and Disston Plastalloy ideally suited to their needs. Each is an exceptionally fine product that has resulted from long, close association with the plastics industry and years of experience in the production of better steels.

PLASTIRON is melted and hot-worked with great care, and is as clean and soft as the steel making art can produce. It assures good, uniform hardness upon heat treatment, and is specially recommended for intricate shapes and short runs.

PLASTALLOY produces the greatest core strength and resistance to abrasion consistent with ease of hobbing. It is finding an increasingly wide field of applications as mold requirements become more exacting. The hardened case is very fine-grained and strong.

Both PLASTIRON and PLASTALLOY are produced by modern steel practice from carefully selected ingredients, in electric furnaces, and under careful control. Each has these important advantages:

- A low carbon content.
- Thoroughly clean and uniformly sound.
- Produces unusually smooth cavities.
- Will withstand extreme hobbing.
- Carburizes evenly.
- Ideal for difficult shapes.

CONSULT DISSTON ENGINEERS REGARDING YOUR POSTWAR PRODUCTION PROBLEMS

You will find the wide experience of Disston engineers and metallurgists helpful in the development of your postwar plans. They will be glad to help you arrive at the right solution to any molding or hobbing problems you now have. You may consult them freely, in confidence, and without obligation. When writing, please give full details.

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GEARED TO CUSTOM MOLDING Exclusively

HERE AT CMPC we're committed to just one job . . . and doing that job well. We have no products of our own. We have nothing to offer the dealer or jobber. Instead, all the effort of our seasoned organization . . . all the facilities of our modern 2½ acre plant . . . are devoted to the important task of producing good plastic parts for the manufacturers we serve.

Results have proved the wisdom of this policy. It has enabled us to give undivided attention to the needs of those we serve . . . to make their problems our problems . . . to become, in effect, the customer's plastics molding department. With an organization geared to custom molding exclusively . . . meshing our knowledge with that of our customers . . . giving them the full benefit of our quarter century of experience in plastics . . . assuming undivided responsibility for designing, mold making, molding, and finishing . . . we have built up a nationwide reputation for quality in molded plastics . . . for doing even the tough jobs well.

This is one more reason why you'll find CMPC a good place to come for your molded plastic parts. When you're ready to discuss plans, just ask for a CMPC Development Engineer. There's no obligation.

CHICAGO MOLDED PRODUCTS CORPORATION

Plastic Molders

1046 N. Kolmar Ave. Chicago 51, Illinois

BRANCH OFFICES IN PRINCIPAL INDUSTRIAL CENTERS

WOULD A

50% Assembly Saving

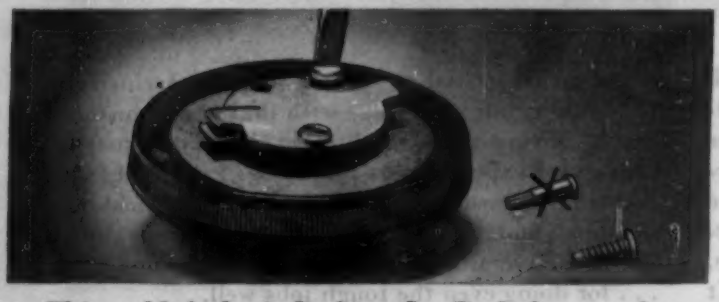
HELP YOUR PRODUCT BEAT POSTWAR COMPETITION?

CUTTING ASSEMBLY COSTS IN HALF is nothing unusual for P-K Self-tapping Screws *the short cut fastening method!* Records of thousands of applications show frequent savings of 30 to 50%.

THERE'S NOTHING EXCEPTIONAL about such savings, either. In 7 out of every 10 jobs submitted for fastening survey, it was found that P-K Screws could eliminate tapping – speed assembly – lower costs – reduce spoilage – improve strength and rigidity.

WHY HANDICAP YOUR PRODUCT in the postwar market with needlessly high assembly costs? Change over now to the short cut fastening method – *before* production starts!

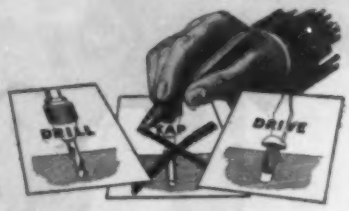
CHANGE OVER FROM STUDS TO P-K TYPE "Z" NETS ASSEMBLY SAVINGS, IMPROVES PRODUCT



This molded plastic Locking Gas Tank Cap was first designed for assembly with the special stud illustrated. But the manufacturer wisely "questioned fastenings" and found that P-K Type "Z" Screws would save operations – simplify the job – add far greater strength – and permit disassembly if needed. Make sure of similar savings and improvements in your product... clear out needless fastening "bugs" now!

HERE'S HOW TO START ASSEMBLY SAVINGS WHEN YOU START PRODUCTION

1. QUESTION EVERY FASTENING in your plans. Ask – "Can it be done the simpler way – with P-K Self-tapping Screws?" – before you O.K. more complicated methods.



2. WITH THE "USER'S GUIDE" (free to assembly planners on request), find out how and where you can use P-K Self-tapping Screws to eliminate tapping, costly inserts in plastics, awkward bolting and other "slowdown" methods.

3. ASK A P-K ASSEMBLY ENGINNEER to go over your plans with you – to make sure you don't miss any chance to save. You'll find his advice unbiased, because Parker-Kalon makes all types of Self-tapping Screws. Or, send assembly details for recommendations. Parker-Kalon Corporation, 208 Varick St., New York 14, New York.

PARKER-KALON

Quality-Controlled SELF-TAPPING SCREWS

For Every Metal and Plastic Assembly

here's what radio frequency preheating can do in **molding plastics**

These are case-study figures of the application of Westinghouse Radio Frequency preheating of preforms at a large manufacturing plant.

They show the astonishing versatility of r. f. preheating in achieving high production at low costs. In this particular application of r. f. preheating, the mold cost only $3,360 compared to $10,670 for standard compression molds . . . an initial saving of more than 66%!

The bar chart above illustrates how such exceptional savings apply in every phase of r. f. preheating. And the flexibility of r. f. preheating adapts it perfectly to many operations . . . it is ideal for making parts with long, slender holes because the reduced pressure does not bend or break mold pins. Metal inserts can be molded better by the r. f. technique.

Standard ratings are available from 1 to 20 kw, and up to 200 kw if your application requires this power. You can learn more about Radio Frequency preheating and its applications to your molding by writing your nearest Westinghouse office. Or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-08108

Westinghouse

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Electronics at Work

IT COSTS NOTHING TO INQUIRE *but a* LOT *to* EXPLORE!

A RESERVE of new, low molecular weight mono and dibasic acids and their esters is waiting in our research laboratories to fit into the many new developments in the field of thermoplastic resins and elastomers. The press of wartime production has, in many cases, hastened the development of these new products. But it has also prevented our talking too much about them, particularly with reference to the multitude of peacetime applications that will exist.

But notwithstanding, here is one good example, Emery's Plastolein X-55.

Bed cribbing which must resist perspiration, staining agents, alcohol, other medicinals and inorganic salts, cannot lose these qualities because the plasticizer has a materially lower resistance. Obviously too, the plasticizer cannot leach out, sweat out or evaporate, if flexibility is to be retained. Plastolein X-55 has continued to meet these requirements in the manufacture of flexible, impervious bed sheeting.

Two EMERY DEVELOPMENTS

L-110 AZELAIC ACID

$C_7H_{14}(COOH)_2$

Melting Point.....90°C
Combining weight.....93-95
Solubility (water) ∞ @ 100°C
Solubility (alcohol) slight @ 25°C

EMERY'S PLASTOLEIN X-55

A glycol ester of pelargonic acid ($C_8H_{17}COOH$), which is compatible with a wide variety of resins including nitrocellulose, other cellulose base plastics, and the vinyls. To these it imparts excellent low-temperature plasticity, with good ageing characteristics and freedom from sweat out.

EMERY INDUSTRIES, Inc.

SEBACIC ACID • OLEIC ACID • ANIMAL, VEGETABLE AND FISH OIL FATTY ACIDS
TWITCHELL PRODUCTS • PLASTICIZERS
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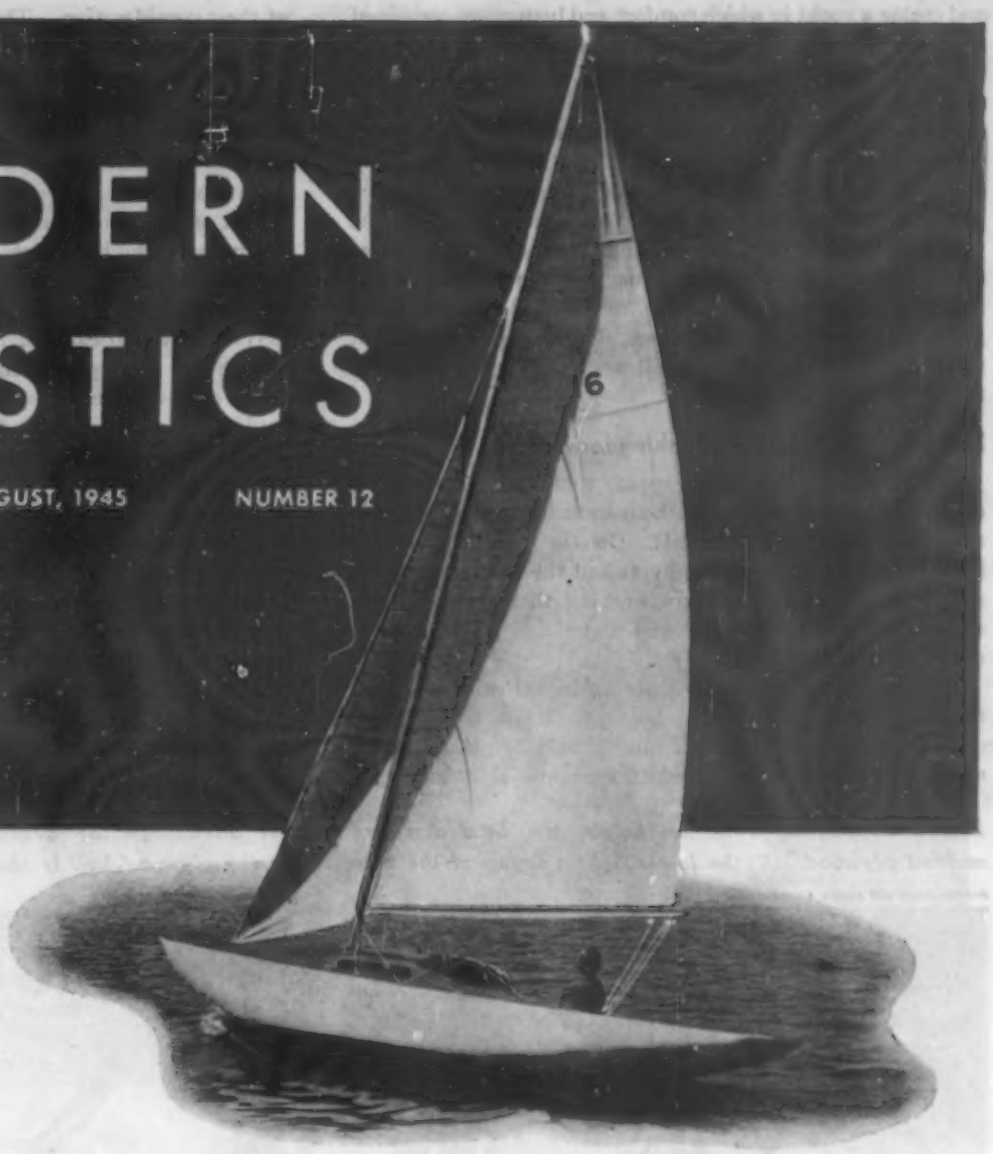
MODERN PLASTICS

VOLUME 22 AUGUST, 1945 NUMBER 12



Greater latitude in the design of the hull and fewer maintenance headaches for the skipper, highlight the use of molded plywood for pleasure craft such as the L-16

PHOTO, COURTESY LUDERS MARINE CONSTRUCTION CO.

New materials on the water

BOAT builders and naval architects have long been considered incurable traditionalists. Skilled craftsmen painstakingly have built seaworthy yachts from teak and mahogany and brass, and persons fortunate enough to own these boats bring them through the seasons with devoted caulking and sanding, painting and polishing. Boats have been very expensive. Therefore the demand has been small. It hardly has seemed worth while to challenge the tradition.

But war is more demanding than pleasure or sport. With Pearl Harbor came the need for PT boats which could take the buffeting of choppy waters at incredible speeds; for lifeboats light enough to be airborne, strong enough to crash on heavy seas; for boats and marine equipment which could withstand the corrosive effects of extremes of climate; and, above all, for these and hundreds of other types of coast guard, landing, river crossing, engineer and naval small craft to be constructed by the thousands in record-breaking time with no sacrifice of dependability.

Traditional production techniques were not fast enough, nor were traditional materials always suitable. Under the stimulus of the national emergency, the boat industry began to break with the past.

New interests entered into the boat industry, namely, plastics material suppliers, molders, laminators and aircraft manufacturers. And now the same daring ingenuity which was unleashed for war-craft production is being carried into plans for the building of pleasure craft.

Plastics in peacetime boat building

Plastic materials may be said to be one catalyst which is bringing about new thinking at the waterfront. But at the present time it appears that plastic utility will be in inverse proportion to the size of the boats built. Thus, the rosiest field for plastics will be in the smallest classes; i.e., dinghies, top-o-car boats, outboard motor boats, racing shells, canoes, small sloops, kayaks and large rowboats. In the larger stock sailing boats and cabin cruisers, plastics will be used for exterior and interior purposes in an effort to bring down cost

and create a yacht in which comfort and luxury are combined with ease of operation and maximum efficiency.

In the larger yachts, over 60 ft. l.o.a. (length over all) the usefulness of plastics begins to diminish. In the luxury class, many architects still seem more interested in getting the best older materials than in experimenting with new ones. From the aesthetic viewpoint, designers of these boats claim some plastic materials offer "too cheap" an appearance. As the versatility of expensive veneers, and the availability of more subtly toned molded plastics, flame retardant laminates and improved resin coatings, fabrics, mechanical and structural parts become more widely known, it may be hazarded that some of the plastic materials will meet with better reception among luxury yacht builders.

Not all of the industry is looking forward

From the foregoing it may appear that with the exception of custom yacht builders, the boat industry generally favors new techniques and materials. On the contrary, only a limited number of naval architects and the more progressive shipyards are as yet actively working with industrial designers, research laboratories and materials suppliers on the use of plastics.

There are many architects absorbed in war work or unable to get materials for civilian boat production who are not opposed to the use of plastics but simply are not "up on" recent developments which make these materials more worthy of their consideration. These men have commissions to design new boats piling up on their drafting boards—they feel there must be many places on a boat where plastics could be used to advantage. Over and over they say, "Let us know what's going on. Send us sales representatives with material samples and test data. We're eager to try anything that's been proved."

But on the other hand, there are some designers and boat enthusiasts who have recently gone on record as vehemently opposed to any departure from time-tested materials. Some of this negative reaction stems from extreme designs by which certain non-nautical designers have attempted to show the public how large plastic shapes could be compound molded. Some of it was caused by aggressive sales of products which had not been sufficiently tested for use on the water. But most of the opposition may be attributed to the high degree of caution with which all types of products are accepted by the marine trade.

Boat owners claim that there is nothing so corrosive as the combined effects of salt water, salt haze and blazing sun. They declare that theory is all very well but you can never tell how a material will behave until it has been exposed to a season's wear followed by a winter in dry dock. They add that it is one thing to test a material for weather exposure or submersion, quite another to put it into actual use where motor vibration, high speeds, heavy seas and any number of unforeseen conditions will prove it unseaworthy.

Poised above the water on hoists, the L-16 displays to best advantage the graceful construction possible with molded plywood. At the lower right a layup of the veneers for the plywood hull is shown in preparation for the mold

PHOTOS, COURTESY ALLIED AVIATION CORPS.

Right—Plans are now being made for the mass production of molded plywood hulls for pleasure cruisers, such as the experimental model shown. Below—Possibilities of peacetime production of pleasure craft are suggested by this view of ramp landing boats being turned out in quantity

PHOTO, COURTESY [illegible]

PHOTO, COURTESY [illegible]

These men also warn the plastics industry not to go overboard on molded boats. "Work closely with men who know boats," they say. "Remember that it would take but one or two fatal accidents in the water to do the plastics industry irreparable harm. Wood may have its disadvantages, but they are well-known disadvantages. We know how to work with it—what it will do in every circumstance."

It is apparent that a selling job remains to be done in the pleasure boating field. Test figures, cost data, comparison statistics, plus an alert consumer merchandising program will be repaid in architects' specification sheets.

Should shipyards subcontract?

If it is advisable for the plastics industry to maintain close contact with boat experts, it is equally important for those shipyards wanting to produce molded and laminated parts to keep in constant touch with the plastics industry.

Many builders will wish to save the middle-man expense of subcontracting. In fact some companies which were primarily boat builders before the war have created active plastics departments and developed laboratories to deal with wartime problems. Other companies plan to buy molding equipment as soon as restrictions are lifted. Then there are the molders of large laminated shapes, such as fuel tanks and fuselages for aircraft who are interested in the boat field because it entails no great retooling or change in technique.

On the other hand, many molding firms believe that a good proportion of the boat yards will choose to subcontract work on molded hulls and laminated timbers rather than buy expensive machinery and struggle with technical problems and methods to which answers are gained only by experience.

Hulls for pleasure craft

It is around the question of hull materials and construction that most controversy rages, for hull architecture can be traced back to ancient times when two methods were open to the builder. These methods involve 1) construction of the boat shell into which the stiffening ribs and cross ties are subsequently fitted or 2) the building of a framework of requisite size and shape onto which the outer skin of the boat is then attached. In both types of construction the skin or shell may be fastened together either in the carvel-built method (in which the planks are laid edge to edge so that they present a smooth surface without) or in a clinker-built method (in which the planks overlap).

With the introduction of plastics as a material for hulls a number of variations in these two conventional methods have made their appearance. A builder may now build a carvel or clinker planked boat over a frame which is constructed not of plain but of laminated timbers (resin-glued smaller sections). Or, over a conventional frame, he may build a plastic plywood shell plating.

Even more important, through the use of plastics, builders are able to break entirely with the traditional methods. Using

Left—Unbroken lines and a smooth, even surface feature the hull of this sailboat, molded of impregnated sisal fiber

Below—Previously a number of sections were required for hull and deck of this outboard motor boat. Use of impregnated sisal fiber reduces construction to one mold for each part

a molded plastic plywood or other type laminate, hulls can be built without the stiffening framework, for the molded construction and the strength of the material carry the stresses throughout the whole surface. This is the monocoque type of construction which has been used so extensively in aircraft. Also abandoned in some cases is the carvel and clinker method of laying on the shell—for when sheet plywood is used the shell plating is laid on in prefabricated sections.

Sheet plywood for hulls

The first introduction of plastics into the exterior parts of pleasure boats came with sheet plywood used in non-structural members, i.e., for cabin walls and roofs, for decking, planking, and later for side-plating from deck to chine. Many architects who today display displeasure with plywood are still conversant only with veneers bonded with albumin and casein glues. Development of phenolic and resorcinol-formaldehyde resins with greater strength and resistance to water and fungi has altered the picture. Now, sheet plywood is used for hull plating on landing, torpedo and coast guard craft.

Many boats, both large and small, will undoubtedly use sheet plywood for hull plating after the war. Typical is the Gibbs Gas Engine Co. line, including a 16-ft. l.o.a. inboard motor boat, light enough to be carried on a two-wheel trailer. Use will also be made of sheet plywood by manufacturers of precut boats. The Doane Marine Works, for example, will precision cut parts for subsequent assembly by individuals and boat yards equipped with the proper tools.

Hulls of molded plywood

The molded plywood hull has seen a great deal of wartime service. It is roughly estimated that over 5000 boats of molded hull construction have been produced for the various services. It is this type of construction, in conjunction with resin-bonded laminated timbers, that was selected for the Army and Navy droppable lifeboats, which were designed to be dropped by parachute from altitudes of 1200 to 1500 ft.—a test of strength characteristics if ever there was one.

With allowances for variations in technique, the process is essentially as follows: The wood veneers come to the molding plant in flitches. After the edges are straightened into desired shapes, the veneers are spread or sprayed with resin adhesives, stapled on a male form (usually made of wood) in long thin strips conforming to the boat pattern which assumes the shape of the mold.

Following the laying-up, the die is covered with a rubber blanket which transmits heat and pressure but, when sealed at the edges, excludes steam. Placed in the autoclave the work is subjected to rigorously controlled heat and pressure to polymerize the resins. After a specified time, the final shape is removed from the autoclave, stripped of the rubber bag, and cooled with water spray.

Molding companies are planning to produce small craft molded of resin-bonded plywood in the thousands. William J. Deed, naval architect, has designed two models, each of which will cost in the neighborhood of $65. One, a canoe of conventional design, will weigh about 100 lb.; the other, a 14-ft. cockpit or outboard hull, will weigh but 60 pounds.

Another molding company has been experimenting with a 12-ft. racing and motor craft model designed by J. Murray Watts, naval architect, to be molded of $^1/_4$- to $^3/_8$-in. Spanish cedar and mahogany veneers bonded with phenolic contact

resins. The Kit Kraft Co. has asked a molding firm to furnish them with a line of phenolic-bonded plywood molded one-piece hulls of varying designs for sale to boat companies and individuals who wish to complete their own boats.

Perhaps the work that has most captured the imagination of those who are considering the use of molded plywood materials in boat building is that of the Luders Marine Construction Company. This May, after a year of experimentation, Luders delivered twenty-five 16-ft. l.w.l. (length water line) boats to sailing and racing enthusiasts.

The advantages resulting from the molded plywood material are clearly evident in the L-16, as the Luders' boat is called. Its upkeep is minimized due to the fact that the molded plywood stays put once it is built. Seasonal painting is of a minor nature, and there are no seams to come and go.

There is a considerable strength-weight gain when plywood is used. Plywood, the strongest material for its weight known, can be 40 percent thinner than wood (and consequently lighter) and still be stronger. It is estimated that an Army lifeboat hull weighing 245 lb. when built of resin-bonded plywood would weigh 600 lb. in wood. This weight saving is due not only to the reduction in the thickness of skin, but to the fact that molded hulls can dispense with all or many heavy oak ribs, bolts and fastenings.

A further advantage of using resin-bonded plywood is the latitude it permits in hull design. In building the L-16 it was possible to construct a pointed bow and a rounded stern since plywood can be formed into such shapes without wastage of material as would have been the case if lumber had been used. It is claimed that the stress-skin construction means that the boat is better able to take the stresses and strains of choppy waters and high winds.

Plywood has high rot and teredo resistance due to the protection the resin gives the wood fiber. Another point in its favor is that contact with submerged rock or flotsam will only puncture a plywood hull—the material will not split since there is no plane of cleavage. And with all the advantages gained by this type of construction, the Luders' boats will cost no more when made in quantity than conventional boats.

Three years of service use and "the hulls are in perfect condition and show the effects of service much less than any conventional hull" is the report of the Gordon Douglass Boat Co. concerning the 14-ft. l.w.l. international class "snipes" which were molded by a plywood company soon after the development of the bag molding method. Because these sailing boats are strong, light, easy to build and to maintain, this company will add 17- and 21-ft. l.o.a. boats to its postwar line.

Many designers believe it will be more economical and speedier to mold large postwar boats in sections. By edge gluing veneers into larger sheets which fit into the sectional pattern, considerable hand labor may be avoided.

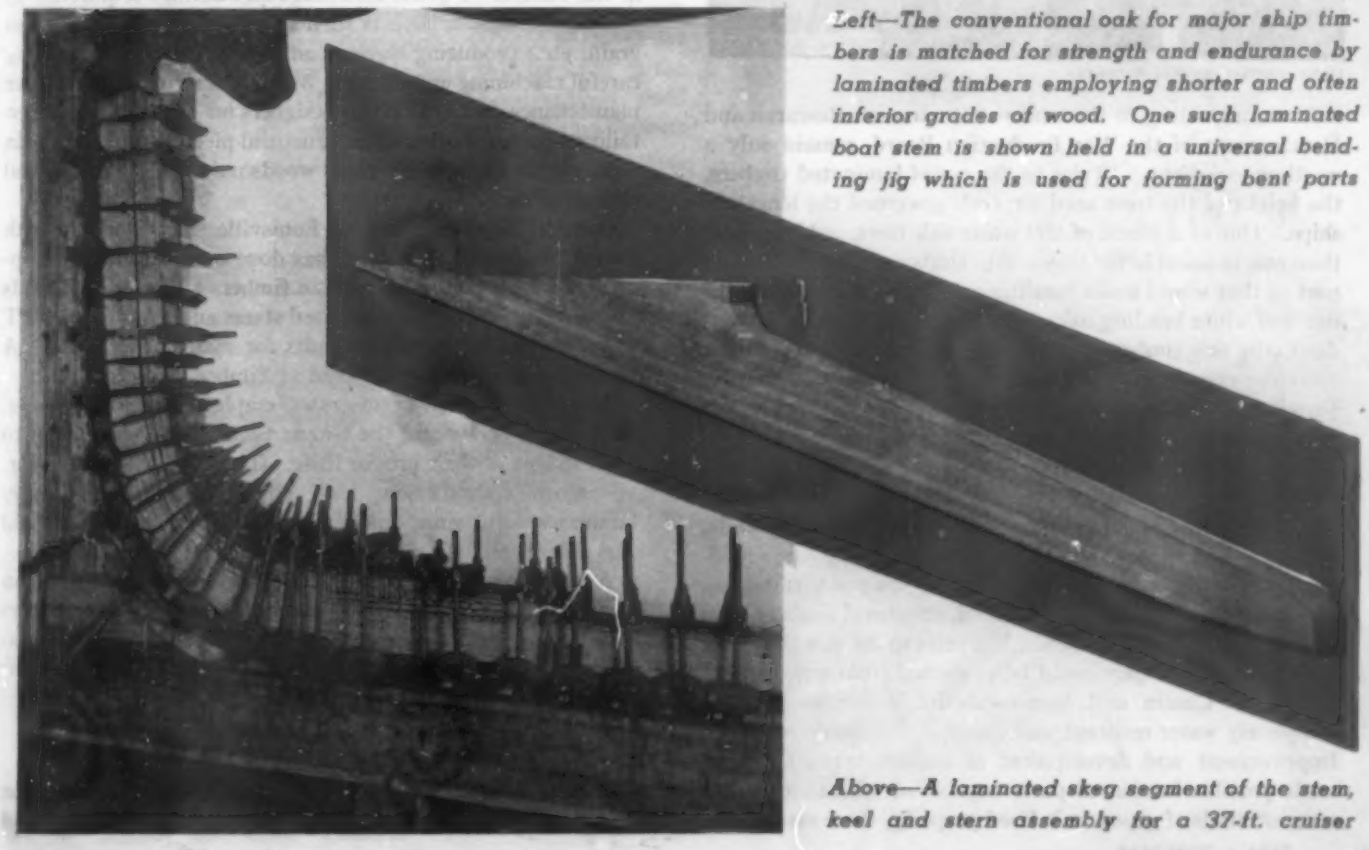
The Richardson "Cruisers of Tomorrow" will be built in this manner. This line of five cruisers, all based on the same 25 ft. $3\frac{1}{2}$ in. l.o.a. hull having a draft of $23\frac{1}{2}$ in., was designed by Sparkman and Stephens. The five sections of aeroplane grade stock plywood which comprise each hull include two sides from deck to chine, bottom from chine to keel, stern section, and forward deck, all bonded together with a phenolic resin. The cruisers, including motor, will range in price from about $3500 for the covered cockpit sedan cruiser to $1800 for the open cockpit utility craft.

Laminated timbers

When the Navy small boat program ran into difficulties in procuring enough suitable timbers for its gigantic needs, synthetic glue manufacturers were called upon to formulate resins capable of setting at a lower temperature than the boiling point of water. Such a resin was necessary to prevent excessive loss of moisture from wood in large laminated cross sections during drying and consequent weakening of the structure.

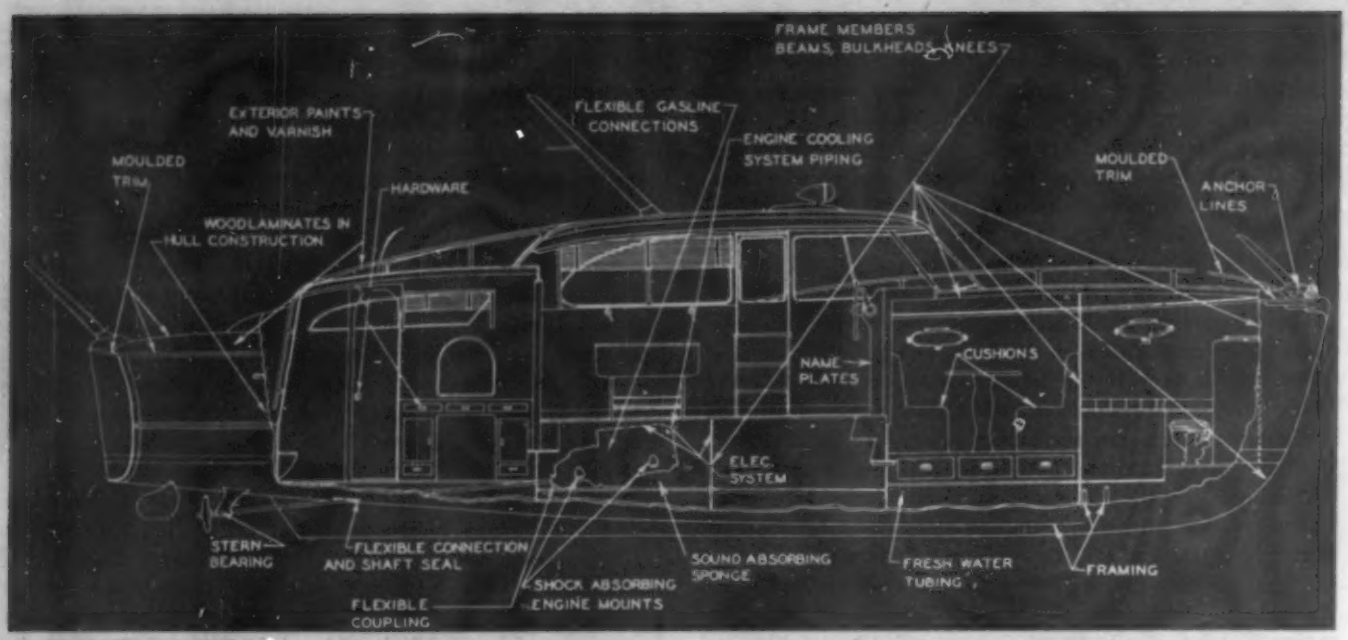
The resins which were formulated to meet this situation

PHOTOS COURTESY GAMBLE BROS., INC.



Left—The conventional oak for major ship timbers is matched for strength and endurance by laminated timbers employing shorter and often inferior grades of wood. One such laminated boat stem is shown held in a universal bending jig which is used for forming bent parts

Above—A laminated skeg segment of the stem, keel and stern assembly for a 37-ft. cruiser



DRAWING, COURTESY OWENS YACHT CO.

PHOTOS, COURTESY HERCULES POWDER CO.

Above—Blueprint of a deluxe cabin cruiser detailing some possible uses of plastics in motor parts, fittings and hull construction. Left—Seabeard heavily encrusts a section of a steel ship. Right—Another portion of the same boat, treated with antifouling paint, still unencumbered after a comparable period of exposure

will not, according to the Office of Production Research and Development of the War Production Board, remain only a wartime expedient. "Prior to the use of laminated timbers, the height of the trees used for keels governed the length of ships. Out of a forest of 200 white oak trees, seldom more than one is suitable for major ship timbers and only a small part of that would make bending oak. To procure quantity items of white bending oak, 20 ft. long, 5 in. thick and 17 in. deep (the size timbers needed for skegs or outer keels) it is therefore necessary to use laminates." Laminated members permit the use of up to 60 percent low-grade and short length material in the interior sections.

Parts and sections produced to advantage by laminating include aprons, deck beams, binding strakes, booms, cappings, dead-wood, frames, horn timbers or counter timbers, keels, keelsons, knees, mast stepping, risers, shaft logs, side fenders, spars, stems, stern posts, stringers, towposts, transoms.

As with sheet plywood, laminated structural timbers have been in use for over ten years. But prior to the war they were useful only when they could be protected from weather and humidity. Casein and urea-formaldehyde resins are not completely water resistant and casein is not teredo resistant. Improvement and development of various types of resins made possible laminated parts capable of withstanding the severest kinds of exposure. Used properly, these resins form a joint stronger than the wood itself. Curing is effected in a heating chamber which is equipped with automatic heat and humidity control.

Advantages of lamination are: 1) the economy of labor for the shipwright in the final shaping of the boat, as well as consequent economies of weight and cost through reduction in the number of bolts, fastenings and fittings required. 2) The elimination of defects such as knots, holes, splits, cross grain, etc., producing obvious advantages in parts requiring careful machining and fitting. 3) Greater rigidity. 4) Lower maintenance cost. 5) When designers make use of laminated tailored parts for other than structural pieces—rounded cabin sections, for example—various woods may be used for special characteristics.

Gamble Brothers, Inc., of Louisville, Ky., working with Forest Products Laboratory, has done considerable development work on laminated marine timbers and produced keels for over 11,000 landing craft, and stems and keels for 100 PT boats as well as stern post units for many other ships. A second pilot plant is established at Timber Structures, Inc.

Many of tomorrow's cruisers will employ laminated timbers. Both the Wheeler and the Owens yachts have used them to some extent in their prewar lines. The Owens 30-ft. cruiser, of prewar construction, used phenolic-bonded mahogany laminates for beams, knees and gussets in a conventional carvel-built hull.

A word of caution, however, comes from the American Bureau of Shipbuilding. "In speaking of laminated members so much depends on the construction, the method of lamination, the type of wood, the manufacturer and the hull that it is hard to give a blanket endorsement."

Composite laminates in hull construction

In introducing the subject of plastic laminate hulls to the yachting public a great deal of specific information would

seem advisable. What must be made clear is the amazing increase in the strength of plastic moldings when a fiber reinforcement is added. Reinforcing materials include glass cloth, canvas paper, manila fiber, rope yarn and needled felt. This is one field in which development is proceeding apace.

Sandwich constructions in which the outer cores are of canvas or mahogany veneers with the low-density cores of air-filled regenerated cellulose, glass fiber in a honeycomb construction, or styrene fiber, offer promise that a buoyant material is on the way. In models which have been developed up to the present time buoyancy compartments, in many cases filled with expansion plastics, have been safety factors.

The Ventnor Boat Works are engaged in the development of structural plastic laminates for use in the fabrication of molded hulls and deck sections. They propose to mold their postwar line of racing and pleasure cruisers complete as integral units, combining the necessary reinforcements into the shell. They believe that in this way they can achieve greater utility at considerable saving of labor. The aim of the Ventnor yard is to get as much "boat for $1000 as you can get car for $1000." The relative cost of tooling and molding operations should be inexpensive.

An experimental 12-ft. dinghy built by a plastics materials manufacturer has been the basis for much development work by molders and boat companies. Materials consisted of 30 lb. of cellulose acetate, 5 lb. of diethyl phthalate, 8 plies of 8 oz. Osnaburg duck. The assembly was 1/4 in. thick. The weight was 35 lb. for the cloth, 35 lb. for the plastic and 60 lb. for the fittings. It is estimated that this is the equivalent of a 160-lb., all-wood boat. A direct cost estimate of the boat is as follows:

40 lb. of plastic at 30¢ a lb.	$12
40 lb. of cloth at 15¢ a lb.	6
400 lb. of solvent (lost in operation as it dries up)	20
16 man hours at $1.50 an hour	24
	$62

An experimental 17-ft. centerboard-type sloop-rigged sailboat molded of phenolic impregnated sisal rope fibers[1] shows the refinements of design possible with this material at the same cost (when produced in quantity) as conventional wood hulls. The ease with which the material is formed makes possible any streamlining deemed practical by the designer. The new type of wide-curved bow—a dry type of construction seen in many new boats—is easily produced from this material as are the combination round-and-vee-bottom hulls incorporated in the boats designed by Egmont Arens for Plastic Boats —Lake Placid, Inc.

This company disposed of hundreds of molded plastic shells to amateurs who built kayaks, racers, catamarans, ice boats and other playcraft from them. These shells, intended for the U. S. Navy streamlined jettison gasoline tanks, were made of phenol impregnated cordage fiber. Weighing only 20 lb.,

PHOTO, COURTESY E. I. DU PONT DE NEMOURS & CO., INC.

PHOTO, COURTESY ROHM AND HAAS CO.

[1] "Sailboats with molded hulls," MODERN PLASTICS, *22*, 119 (July 1945).

Above—Sailmakers and sailing enthusiasts look forward to the return of nylon for the spinnakers of their racing craft because of its smooth, flat, nonporous surface and high "stretch recovery." Where elasticity is not a prime requirement, other synthetic fibers will be employed. Right—One materials manufacturer suggests the practicality of acrylics for inboard motor boat windshields, providing the salt spray is hosed off after contact

the leakproof streamlined shell when equipped with flotation factors of wood or sealed gallon tin cans, floated on the water "like a feather." Arens tested the shell by leaving it for 18 months, winter and summer, in salt water at the water's edge where the tide rose and fell. After exposure to mud, ice formations and various extremes of weather, it showed no effects of weathering at all.

At present, coating with regular marine paints is considered advisable to prevent the small amount of water absorption which will occur. Those partial to the reinforced plastic materials believe that eventually color may be molded in.

Summing up, advantages claimed for composite laminates in hull construction are: 1) increased service life, 2) no seams, 3) weight saving, 4) increase of utility, 5) greater loading strength, 6) less upkeep, and 7) no marine growth.

Superstructures

A hull of molded plywood or reinforced plastic material may be practical even when a great quantity of one design is not wanted, for many models may be based on one hull. But some companies believe it will never be practical to mold cabins, or that at least it will take an expanded market to warrant the cost of molding a one-piece superstructure design with all the compound curves such a section entails. However, others consider a molded superstructure possible if a material is used which allows highly developed curves to be produced at low cost on inexpensive molds.

In an expensive racing boat, points out Richard Davis of Henry B. Nevins, Inc., a molded plywood superstructure would justify great expense since it could be designed with sleek curves unobtainable in wood construction. In all yachts, saving of weight above the waterline is highly desirable for speed and comfort.

Decks

Sheet plywood decks and laminated timbers for decks, much in use even before the war, were used with notable success on PT and other small naval craft where they encountered heavy traffic. Naval architects agree that a plywood underlayer with a mahogany or teak veneer makes a fine deck. Something which can be scraped is needed, but laying teak is an expensive process. The Wheeler yachts employ plywood surfaced with canvas.

Although they have not yet seen commercial use, phenolic impregnated or compregnated veneers and timbers of softer woods may offer the surface that builders seek from hardwoods. Along the same line is transmuted wood—wood treated with a resin-forming series of chemicals polymerized within the structure of the wood. Various proportions of urea and dimethylolurea lessen swelling of the wood, shrinking and warping, and improve hardness and strength without imparting color or odor. With this new process, wood for decks would be chosen for color or graining of the wood rather than for structural qualities since the dimethylolurea treatment, at no appreciable rise in cost, would contribute the strength qualities.

If the hull is molded of low-pressure laminates, it would seem practical in some designs to mold the deck section as well. One company has built an experimental inboard motor craft in which the entire boat is built in two sections; the deck section designed to include seats, fitting over the hull section with allowance for buoyancy compartments. The two sections are joined with a wide flange.

Non-slip deck coverings, using phenolic, vinyl or alkyd resins formulations in which are imbedded crushed abrasive particles such as finely divided fused aluminum oxide, are a relatively new development in which plastic materials play a major role.

Some of these deck coverings are slip-proof, and they are said to be anticorrosive, long wearing, fire retardant, and resistant to oils, greases, fresh and salt water and dilute acids. In addition they are easily applied and maintained, drying in a few hours' time. The plastic resin-based coverings bond to steel, wood or concrete and can be spread right over old canvas. The cost is about one-tenth that of canvas. The non-slip materials can be sprayed on with an ordinary paint spray, dip-brushed or spread on with a trowel, and can take a top coat of paint.

Canvas coatings

Canvas coverings for decks, cabin roofs and hatches, for awnings, tarpaulins and working sails, and for chair materials have always offered a problem to yacht owners. In the case of the canvas deck, for example, color fades badly in one season and checks or cracks usually appear. Sanding down and the application of special finishes is necessary at least once a season. When the canvas becomes irreparably worn, it has to be replaced. Canvas mildews rapidly, becomes very dirty, and cannot be cleaned satisfactorily.

The firm of Hudgins and Ratsey (Ernie Ratsey is the sailmaker of International Cup race fame) has plans to solve these problems by treating cotton duck with vinyl resins. Such diverse military applications as parachute packs for airborne rescue boats, duffle bags, underwater submarine practice targets and sails for rescue boats, show that a resin coating proofs canvas against mildew, rot, salt, oil, acids and alkalis. A test sample lay at the bottom of New York Harbor for 18 months. When brought to the surface it displayed absolutely no signs of wear.

Although the application of a vinyl resin to cotton duck will increase the cost considerably, it is argued that cheaper fabrics may be used. While the coating increases weight 15 percent, there is a tensile strength gain of more than 50 percent. This means that a lighter-weight fabric may be used. As a deck covering, the treated canvas offers a less "skiddy" surface than the untreated, and one completely weatherproof.

Sails

Plastics also enters the sail picture in the form of synthetic fibers. Nylon is said to be ideal for a spinnaker—a sail which is intended to "belly" in the wind—offering a 35 to 40 percent elasticity. Because nylon is extruded in continuous filaments, there is not (*Continued on page 192*)

Waterfront acceptance means product prestige

Because of the tough conditions that marine products must withstand, and because of the devotion with which materials are selected for boats by their owners and builders, products used by yachtsmen are usually well thought of by the layman.

Whatever the future holds, plastics materials are bound up with boat building. And the prestige that will emanate from their acceptance by this hitherto conservative group will be felt in many ways. Farmers will buy plywood for barns because it is marine-grade plywood. Spar varnishes will continue to mean clear protective coatings, suitable for varnishing living room tables. Home owners will buy sailcloth for awnings and summer furniture. The yachtsman's approval is a goal to work toward.

OFFICIAL U. S. NAVY PHOTOS 1

2

1—Nylon fabric armor is somewhat reminiscent of a baseball catcher's body protector except that it has a back as well as a front. 2—This flexible plastic armor consists of a multiplicity of plies of heavy nylon fabric stitched together

Nylon armor protects navy plane crews

As related by LT. ROBERT TEMPLE, U.S.N.R.*

PLASTIC armor for protection of flying personnel, now in production under the direction of the Navy's Bureau of Aeronautics, promises to be one of the most interesting and useful in the long list of plastics applications that are constantly moving to the battle front. Developed under a Bureau of Aeronautics project at Naval Research Laboratory in collaboration with the material manufacturer,[1] the flexible armor is simply a multiplicity of plies of heavy nylon fabric stitched together so that it looks very much like a piece of quilting. The entire sheet is quilted at about four-inch intervals over the area of the garment.

This particular type of flexible armor has undergone thorough laboratory and field testing to prove its effectiveness against small caliber shell fragments (flak) and flying debris. These tests indicate that its performance on a weight basis is superior to metal in resisting shell fragments, and that its flexibility and light weight make it much more comfortable and convenient for the wearer.

Flexible flak vest

The flexible flak vests, comprised of 32 layers of nylon weigh about 18 lb. in comparison to a weight of about 25 lb. for the metal flak vests presently in use. Each ply weighs $^1/_{10}$ of a pound per square foot. The vests are made in three pieces—front, back and apron. The apron is attached to the front piece so that the user may easily cover and protect his lap when sitting down. The front and back are clipped together by fasteners at the top and hang from the wearer's shoulders. They are tied securely around the wearer's waist with a fabric strap. An emergency release has been devised to unloosen the armor with one quick jerk at the tie string. The entire suit is so flexible that the wearer may use his arms and body without interference. This is in marked contrast to the metal armor suit which is less comfortable, heavier and less flexible despite all efforts to overcome its rigidness through the use of small overlapping panels sewed in fabric pockets. Not only do the flexible nylon vests provide an equal degree of protection but they afford a greater area of protection for less weight. Furthermore, the plastic armor offers uniform protection over the covered area.

Flak curtains

The 24 by 48-in. curtains, which are used in planes wherever needed to protect crew members from flak, look like a quilt for a child's bed. A single curtain consists of 15 layers of nylon fabric stitched together. Even though the nylon curtain weighs only 10 lb. in comparison to the 20 lb. for the metallic curtain now in general use, the lighter nylon curtain provides approximately equal protection. Highly adaptable because of their light weight and flexibility, these curtains may be easily placed and arranged to provide protection where it is most needed.

Nylon flak curtains and vests are not intended as protection against armor piercing projectiles. Neither are they intended for protection against small caliber bullets such as fired by rifles, machine guns or pistols. They stop the fragments from

* Plastics Section, Bureau of Aeronautics.
[1] E. I. du Pont de Nemours & Co., Inc.

high explosive projectiles which are the cause of most casualties to flight crews.

The importance attached to body armor is indicated by a report published in the *Washington Post* on July 30, 1944, which quoted Brigadier General Malcolm C. Grow, surgeon of the U. S. Strategic Air Forces in Europe, as saying that of 133 airmen struck by flak or other missiles while wearing metal body armor, two-thirds completely escaped injury. Only 10.5 percent were killed or seriously wounded. No injuries at all were inflicted on 65.5 percent of those wearing the then prevalent armor. The same article went on to state that considerable difficulty was experienced in persuading the men to wear the armor which "covered them from neck to hips, guarding from spent bullets or shrapnel which originally accounted for 85 percent of the wounds among bomber crews. ... It was too heavy, many of the wearers thought, and too cumbersome."

This development was possible because of the great tensile strength of nylon fibers. The nylon fabric used for this armor was especially designed for the purpose. It is designated as NFD 202/1, woven in a two by two basket weave, from 210/34 yarn having a minimum of 7 gm. per denier strength. Even stronger nylon yarn is now being produced for use in fabric armor, having a strength of 8 grams per denier.

3—The flexible nylon armor for airplane pilots, which consists of a front, back and apron, weighs 18 pounds. 4—Flak curtains, 24 by 48 in., are used in planes wherever they are needed to protect crew members from flak

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4

Research and development

The Navy Bureau of Aeronautics has been working on the development of plastic armor for three years at the Naval Research Laboratories. The idea started crystallizing in the minds of the researchers handling a project which had as its original goal the development of a transparent armor that could be used as a substitute for bullet-proof glass. The object was to save weight.

Experiments with solid sheets of such plastic materials as acetate, methyl methacrylate, ethyl cellulose, etc., were carefully carried out, but none of the materials tested had the required ballistic properties. From these experiments the next step was to test laminates of high strength film such as nylon. It was discovered that some of these laminates, although opaque, had interesting ballistic properties. From there on it was a logical progression to investigate high strength fabrics such as nylon for body armor.

In connection with this work it was necessary to investigate the effect of a variety of weaves and subject them to various tests. In addition, the effect of fabric weight, finishing methods and other variables had to be tested and evaluated in order to find the optimum fabric for this strenuous use. In the investigation of bonded laminates various other factors such as pressure, temperature and sizing, had to be studied and compared. Finally, a 13-oz., 2 by 2 basket weave was chosen. The newer 8 gm. per denier nylon is made up into a 4 by 4 basket weave.

As a result of the testing methods and equipment developed by the Naval Research Laboratory and increased knowledge of the basic theories regarding ballistic performance, other plastic armor materials based on high strength fabrics have been developed. In this connection it is interesting to note that nylon fabrics laminated with nylon and other resins are being investigated with a possibility that they can be used in panels or molded into compound shapes such as helmets.

The business of testing nylon armor is an interesting story in itself. Evaluation of the usefulness of this armor has been carried out on the basis of laboratory tests at the Naval Research Laboratory and field tests at the Naval Proving Ground, Dahlgren, Virginia. These latter consisted of 20-mm. high-explosive forward spray fragment tests. The material to be tested is set up in a panel on a target range and a steel sheet placed about 3 ft. in front of the target. The fired projectile detonates on striking the thin steel panel and the fragments are sprayed on the test panel. Nylon armor has proved more efficient than any other material.

Heretofore, fragment-resistant armor had been empirically evaluated, primarily on the basis of determining its resistance to a 45-caliber bullet. The Naval Research Laboratory considered this test of very doubtful significance in evaluating flak resistance. Therefore, a laboratory test evaluating flak or fragment resistance had to be developed. From this developed what researchers call a yawed dart test. In layman's language this means, "causing the projectile to hit the target slantwise or on a bias." The word "dart" refers to the core of an armor piercing projectile as distinguished from the jacketed projectile core fired in service. In another test a projectile in the shape of a small parallelepiped strikes the target with random orientation.

Flexible nylon flak jackets and curtains are now being sent to the fleet to replace metal jackets and curtains. An interesting sidelight on this armor lies in the fact that approximately the same amount of nylon is required for each flak vest as would be needed for the manufacture of 432 pairs of stockings. The curtain used as much material as needed for 240 pair.

Buttons in Bloom

KODACHROME, COURTESY TENNESSEE EASTMAN CORP.

Accent on color, ranging from the antique effect of the flower at the upper left to the delicate pastel at the right, makes these cellulose acetate buttons a distinctive costume accessory

THIS summer, the costume button has soared to new heights of popularity. Not only are buttons prettier and more distinctive, but they distract attention from the wartime fabrics and replace the trims, pleats, ruffles and other accents which material scarcities forbid.

Plastics have long been a tremendously successful medium for buttons, from the prosaic mass-produced product that does yeoman service on men's suits, shirts and on all kinds of underwear to individually carved decorations for custom fashions. Millions of buttons went marching off to war on military uniforms, both au naturel and metal plated. In fact wartime restrictions on imports which cut off the supply of shell, rhinestones, ceramics, crystal, pearl, bone and wood as well as the craftsman-like products produced abroad, were an added stimulus to decorative plastic button production.

The three stages of molded button production—(from left to right) as the buttons leave the mold, after they are dipped, and in the final buffed condition

Plastics permit almost unlimited variety in design and color, can be produced economically and have been available in the form of scrap which could be reprocessed and decorated by painting, spraying, dipping or plating. Buttons have been injection molded, fabricated from extruded strips and filaments bent or woven into the desired shape or else carved from rod or sheet.

A novel effect has been created in the buttons pictured above by a new technique in treating the plastic surface. Buttons are rapidly compression molded on small laboratory presses in single cavity dies from pre-heated white or light-colored cellulose acetate pellets. After molding, buttons are plunged into a cooling solution and then bathed in a neutralizing solution to prevent any reactions that might cause tackiness. They are then dipped into a specially compounded dye which colors only the surface. Buttons are then hand-buffed individually so that the dye is removed from the high spots of the design or at any desired point. The color remains in the depressions while the white background is brought out at the buffed areas.

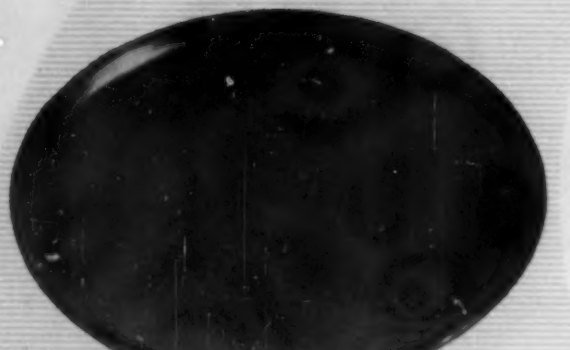
Antique effects have been achieved by spraying the plastic with gold or silver prior to buffing or by applying an additional coat of transparent contrasting dye as in the two-toned flower at the upper left. The colored buttons may be laundered without fading or bleeding, the producer reports.

Credits—Material: Tenite. Molded and manufactured by E. D. Gleich.

A new idea in cooling

1

The problem of adequate air circulation, without the accompaniment of unhealthful draft, has been resolved in a new electric air circulator encased in an all-plastic housing. Directly under the arched top (2) is an inverted cone-shaped deflector (3) which diverts the air circulated by 9 louvers (5). These rings, set so that the lower 6 guide air into the intake field and the 3 upper distribute air outward and upward, are separated by spacers (5). The whole rests on a molded 3-legged base (4), fully insulated



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DRAFTLESS cooling is at last a reality with the introduction of the new all-plastic housing for the Airflight electric air circulator for home, offices and hospitals. This draftless cooling was accomplished by the W. W. Welch Co. through extensive research in aerodynamic engineering, and the job was fully engineered for the specific use of particular types of plastics. The novel principle of this cooler involves the drawing of large amounts of cool air from the lower levels of a room and the constant redistribution of this air as a gently moving mass to the proper zone where cooling is most appreciated. Because of its amazing efficiency and unusual design, the unit soon sets all the air in the room in a definite circulatory motion. There is no sensation of draft because of the new principle of circulatory cooling employed.

As finally perfected, the circulator consists of 18 molded plastic parts—the top, conical deflector plate, nine deflector rings, six spacers and base. The construction throughout

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is "geared to plastics." In fact, the only non-plastic parts in the new product, aside from the motor and fan blades, are six metal tie rods which hold together the 18 plastic pieces.

The base of the unit is a solid three-legged molding thoroughly insulated, eliminating any possible vibration by means of thick rubber spacers. In other words, the motor floats in rubber. It is compression molded of high impact phenolic material, which is the same as specified by the Government for large moldings requiring unusual strength and durability. Furthermore, this plastic will not mar the most highly waxed floor. The legs or feet of the base are identical except that the decorative exterior ribbing is omitted on one leg to accommodate the three-speed switch button for starting and stopping the fan. The legs and the central boss which supports the motor are heavily reinforced by webs or ribs.

Directing the air flow

Mounted on the base and surrounding the fan is a series of nine identical cellulose acetate butyrate tear-drop shaped rings or louvers, designed to simulate the air flow contour of an airplane wing. The upper three rings are so slanted as to distribute the air outward and upward. The bottom six rings are turned so as to guide the air into the intake field of the fan. Between the six lower and three upper rings are six spacers (indexed to the rings to prevent dislodging). These give a symmetrical appearance to the stack of louvers yet permit the slant of the rings to be changed with ease.

This change of slant is so spaced as to come just at the point where the fan discharges the air upward and outward. Thus there is a dead field with absolutely no turbulence or interference between the incoming and outgoing air to lower the efficiency of the circulator. Indeed, even the shape of the six legs which are molded into each of the rings is carefully calculated to help increase the aerodynamic efficiency and streamlined appearance of the unit.

The louvers, which are slightly flexible, are injection molded of cellulose acetate butyrate. The rings are designed with sufficient cross-section and molded of a strong plastic so that even if the unit is picked up by the bottom louver or given rough treatment the rings will not give way. Polystyrene is being considered for these rings.

Placed directly above the fan is an inverted cone-shaped disk called the deflector. This plate helps to divert the air outward in an even flow all around the unit. It is compression molded of phenolic material, as is the gracefully arched disk above it which forms the top of the unit. The top is a molding 15 in. in diameter with a female groove in the rim back of the edge finish bead designed to receive the bead of the deflector. These two parts thus mutually reinforce each other and provide great strength.

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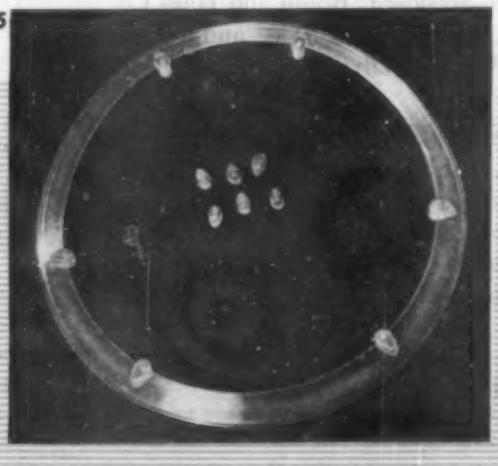

The assembly of these eighteen plastic parts is unique. No exterior fastenings can be seen. The entire unit is rigidly held together by six long threaded studs. Three of these studs (each one of which goes through all the rings and the deflector) are fastened inside of the deflector by being screwed into inserts in this piece. The base, rings and deflector are assembled first as a unit. Then the top with three studs, assembled into inserts in the underneath side, is lowered into position. Speed nuts are put on these studs from underneath, where they project through the boss or ears on the upright legs of the base. The speed nuts on the bottom of the six studs where they pass through the fan base are almost entirely concealed from sight by the ribs of the base. Thus there are no marring exterior fasteners in the assembly. The constant tension of the shakeproof spring fasteners adequately compensates for any cold flow in the plastic components.

To achieve the circulation of a much greater volume of air than is moved by the usual fan, necessary for good results when applying circulatory cooling, a blade was designed with an unusually steep pitch. It is interesting to note that after a thorough study of available plastic blades, and of the costs and performance of a plastic blade of the special design required, a metal blade was finally selected as being equally efficient and silent, and presenting fewer problems in manufacture, assembly and maintenance than a plastic blade.

Why plastics?

All thoughts of copying the metal unit were discarded in order to overcome the dimensional limitations in forming metals and to arrive at a new functional and aerodynamically sound conception of the basic principle of circulatory cooling. Ease of assembly with unskilled help was another factor involved in the design of the all-plastic housing for the circulator. Weight was decidedly reduced without sacrificing strength and durability, and the appearance was enhanced through the use of appealing color combinations, which include two-tone effects and contrasting translucent rings.

The choice of the various plastics was partly governed by conditions of use and of shipment. The base had to be strong enough to support the entire weight of the unit if it should be inadvertently dropped on one leg. The top had to be resistant to abuse by careless smokers, the louvers had to be flexible and rugged in the event that the circulator was picked up by the lower louvers. To withstand all manner of unforeseen abuses, the right plastics had to be chosen.

But the use of a shipping carton of suitable strength and quality to anticipate severe drops and abusive handling during shipment was found to be equally important. In the carton, the unit itself is centered in a square box by corner spacers. The weight of the motor is taken from the legs by a cardboard ring. The gleaming top is covered with soft flannel paper and protected by a spacer from outside damage.

Harmonious and streamlined, the Welch circulator is one of the first articles for home and office to appear, incorporating some of the wartime experiences and advances of plastics. The unit is fully protected by patents on design and mechanical features granted in the United States and abroad.

Credits—Material: Bakelite, Tenite II. Base, top and deflector molded by Plastics Division, Continental Can Co. Louvers molded by Plastic Engineering, Inc. Circulator designed by Alfred A. Fukal for W. W. Welch Co.

W. I. BEACH

HYATT AWARD WINNER

THE fourth annual John Wesley Hyatt Award for outstanding achievement in the plastics industry was presented to William Iler Beach, chief plastics engineer of North American Aviation, Inc., on June 14, for his work on the postforming of laminates which made possible the manufacture of certain critically needed parts for the aircraft industry. The presentation of the gold medal and $1000 was made by George K. Scribner, president of the Boonton Molding Co., who represented the Hyatt Award Committee. J. A. Krug, chairman of WPB, was guest speaker.

It was while work was being done on the design of an all-wood monocoque fuselage and horizontal stabilizer for North American Aviation, that Mr. Beach investigated plywood plastic combination structures and thus became interested in phenolic laminated plastics. But many thousand man-hours were necessary before a process was found which would shape fully cured and dimensionally stable laminated sheet material in the time and at costs which could successfully compete with metal forming techniques.

This process development, which saved strategic metals and contributed greatly to the air war by reducing weight and man-hours on production airplanes, also holds vast peacetime possibilities for the plastics field. Possible postwar uses may include terminal boards for hearing aids, re-enforcing stiffener material for footwear, decorative sheets for sink tops, containers for film and athletic equipment.

The John Wesley Hyatt Award was established in 1941 by Hercules Powder Co. to commemorate the memory of the man who, by his work with cellulose nitrate and camphor in 1867, is credited with founding the plastics industry. It was first awarded in 1941 to Dr. Donald S. Frederick, vice-president, Rohm and Haas Co. In 1942 it went to Frank Henry Shaw, president, Shaw Insulator Co., and in 1943 to Dr. Stuart D. Douglas, head of the Plastics Research Division of Carbide and Carbon Chemicals Corp.

The members of the award committee who selected Mr. Beach as the recipient of the Hyatt award are: Dean Richard F. Bach, education and extension, Metropolitan Museum of Art; Dr. Lyman J. Briggs, director, National Bureau of Standards; Dr. Karl T. Compton, president, Massachusetts Institute of Technology; Watson Davis, director, Science Service; Dr. Stuart D. Douglas, Plastics Research Div., Carbide and Carbon Chemicals Corp.; Charles F. Kettering, vice-president, General Motors; Dr. Carl S. Marvel, president, American Chemical Society; and George K. Scribner. William T. Cruse, executive vice-president of the Society of the Plastics Industry, is secretary of the committee.

The DC-3 in mufti

by B. J. CUMNOCK*

PHOTO, COURTESY BRANIFF AIRWAYS, INC.

1—Nothing about the appearance of this gleaming airliner suggests that it is a war veteran, and has served for two years over world cargo routes. After its release by the Army, it was disassembled and rebuilt in Braniff's shops, and given new interior treatment in a plasticized polyvinyl chloride material

ALTHOUGH there is no record of a point system for aircraft, lots of these honorably discharged veterans are getting out of uniform and into mufti. None has earned its hypothetical 85 more worthily than the DC-3, prewar workhorse of the airlines and, as the C-47, mainstay of the Army's air transport system. And of these, none will be better rewarded than a group now at Love Field, Dallas, Texas, where Braniff Airways has given them jobs and brand new outfits of plastic.

For Braniff, the country's fifth largest airline, these refurbished ships will carry passengers over a system of 3800 route miles which stretches west to Denver, east to Memphis, and from the Great Lakes to the Gulf at Brownsville, Texas, southernmost city of the U. S. Over the 7400 route miles of Aerovias Braniff, a Mexican corporation, they will fly south through Central America and east to Cuba.

The Douglas DC-3, in its Army days rated the most widely used transport in the world, is 65 ft. long, with a 95-ft. wing span, and powered by two Pratt and Whitney 1200-hp. engines. Back in civilian life, it will seat 21 passengers and carry a crew of three. Before each ex-transport assumes its new duties, its interior is given a thorough going over and, by the skillful use of a plastic material, made at the same time attractive, comfortable to ride in and easy to keep clean.

The established decorative scheme for these airliners calls for a gray-green suede-like ceiling, deep wine-colored side panels, and huge sepia-toned photo murals on the forward wall (see Fig. 2). Seats are upholstered in a soft rose color and have wine-colored arm rests and side panels (Fig. 3). The carpets, heater duct covers and foot rests are dark green. In the original design for the reconverted DC-3's, leather was specified for arm rests and side panels, cotton cloth for heater duct covers and foot rests, rubber for lavatory floor mat, leatherette for cockpit interior finish, etc., as in the company's other planes.

These traditional materials have certain drawbacks which, though recognized as such, were borne with because they seemed inevitable. Leather side panels are dented by the toe tappings of passengers or by the sharp edges of luggage carried in the forward cabin. Any sort of scuff marks are difficult to remove from leather and the grained surface scratches easily. At the buffet, coffee or fruit juices are sometimes spilled or splashed, staining the leather wall panels and the upholstery of the hostess' seat. Heater duct covers of cloth need metal scuff plates at each seat to make replacement of the covers as infrequent as possible. Cloth foot rest covers wear rapidly. Both collect dirt, as does the cockpit finish material. Arm rests require frequent attention. Lavatory floor mats crack and show wear. All of this adds up to constant attention if the cabin is to be kept neat, for an airplane may fly as many as 37,800 passenger-miles in a day.

To reduce maintenance to a minimum, the airline selected for the refurbishing operation a plasticized polyvinyl chloride material which matches the original installation so perfectly, both in color and in general effect, that it is almost impossible to distinguish the new from the old. This plastic, a modification of an older polyvinyl chloride material, was originally developed in 1943 as a covering for binocular cases. The type used in the DC-3's represents a further improvement in the formula. It is furnished in sheet form, either rigid or flexible according to requirements, and it is available in various thicknesses, finishes and colors.

The plastic material can be cleaned with ordinary commercial fluids or plain soap and water and, since its color is inherent, needs no lacquering or refinishing. The manufacturer claims that it will outlast conventional materials from ten to fifteen times at point of greatest wear. It is particularly

* Senior maintenance engineer, Braniff Airways, Inc.

BROADCHROMES, COURTESY BRANIFF AIRWAYS, INC.

2—*Forward view of the cabin before the seats were installed. The deep wine-colored side panels and dark green covering for the heater duct running along the floor are both of the polyvinyl chloride plastic*

suitable for aircraft applications because of its light weight—for example, wall panels weigh but 0.35 lb. per sq. ft.; the covering for arm rests, 1.5 oz. per sq. ft.; and flooring for the lavatory, 0.18 lb. per sq. ft. Its general physical properties are as follows:

Specific gravity	1.2–1.6
Tensile strength	2000–3000
Water absorption	under $\frac{1}{2}$ of 1 percent
Abrasion index	250–400*
Resistance to continuous heat	160° F.
Resistance to continuous cold	−50° F.
Tendency to cold flow	slight
Burning rate	nil
Effect of age, sunlight, weak acid, strong acid, weak alkalis, strong alkalis	none

* Comparative abrasion index: tire tread, 100 (standard); linoleum, 20–50; asphalt tile, 15–25; leather, 25–50.

On the reconditioned DC-3, the new polyvinyl chloride plastic appears most prominently in the side panels which run the length of the cabin from the window ledges to the floor. These are constructed of a phenolic laminate composed of saturated 0.10-in. thick plywood veneers and webs of impregnated cotton fiber, faced with 0.010-in. sheets of the polyvinyl plastic. The panels which are prefabricated in lengths and widths to fit their specified locations, are easy to install. An 0.01-in. sheet of the plastic is also cemented to the front and rear cabin walls, where it harmonizes with the murals above it.

The entire panelled section gives the appearance of being perfectly seamless, and trim molding of polished aluminum adds to its good looks. The fine-grained wine-colored material shows no scuff marks and can be wiped clean with soap and water. Pre-installation tests conducted on the phenolic laminate which forms its backing proved that it will hold the metal ash trays set into the wall by each passenger's chair without sagging or tearing out.

Arm rests and side panels of the passengers' chairs are of the same wine-colored plastic, 0.01 in. in thickness and cloth backed. Panels are cemented to the chair sides, while the material for the arm rests is sewn over the padding.

A cushioned layer of the moistureproof polyvinyl chloride material covers the hostess chair forward of the buffet at the rear of the cabin, and the plastic-covered wall panel adjacent to the commissary is carried well up toward the ceiling to reduce the cleaning problem. The interior of the main cabin door is similarly covered to afford protection from sun and rain as it stands open at the airline terminals.

In a molded pyramid design, the plastic material—0.025 in. in thickness and cloth backed—is cemented to the metal surface of the foot rest which is attached to the back of each chair. Here its color is a soft green to match the plane's carpeting. In the same color, weight and design, it is cemented to the metal heater duct which runs the length of the cabin. Because of its scratch-resistant quality, the airline company was able to eliminate the scuff pads which were necessary when the heater was covered with cloth, thus realizing a weight saving.

The polyvinyl chloride plastic is used in various other places throughout the ship's interior. A very thin sheet of it is quilted to the soundproofing in the pilot's cockpit, providing a finish that should last indefinitely and require little cleaning. In the lavatory, it forms the floor mat, the seat cover and the wall panel behind it.

Braniff feels that the future of this and other plastic materials, aeronautically speaking, is bright indeed; and that it won't be too long before such diverse items as the bumper pads of ground equipment, ramp mats, aircraft carpets and counter tops in ticket offices may well be plastic. No one has heard what the DC-3 thinks but, resplendent in its new accoutrements, presumably it favors plastics, too!

Credits—Polyvinyl chloride sheet material by B. F. Goodrich Co.

3—*The same plastic material covers arm rests and side panels of chairs, and the green foot rests on their backs*

PHOTOS, COURTESY FEDERAL TELEPHONE AND RADIO CORP.

In electrical components of such a complex nature as this multi-circuit breaker base, the use of woodflour filled phenolic has been found highly satisfactory

Molding procedure is simplified and even plasticity of the material assured through the use of a high-frequency electrostatic unit, shown here attached to the press

Electrostatic preform heating

by WALTER JACOB* and VINCENT WAGNER†

THE highly desirable electrical properties of many plastics, their comparatively low cost and the ease with which they can be fabricated in large quantities at high production speeds, have made these materials the logical choice for a variety of electrical components. However, the complex structures of many of these parts present the molder with many difficult production problems.

A good example of an electrical component of this type is the base for a multi-circuit breaker which required particularly careful treatment because of its 2 in. depth, 7 in. length and 1⅝ in. width. In addition, the piece was designed with a variable wall thickness and a multiplicity of interior studs, bosses and supporting projections. Specifications called for the maintenance of close tolerances. All factors contributed to make the part a difficult one to produce rapidly, in quantity, at a reasonable cost if ordinary molding methods were followed.

The material selected for the multi-circuit breaker was a standard woodflour-filled black phenol-formaldehyde resin in powder form; the press, a semi-automatic compression molding unit. In the original runs, difficulties were experienced in getting free flow of the material throughout the 4-cavity mold, even when closing pressures up to 140 tons were used. Flash was excessive, considerable hand-finishing was necessary and a substantial percentage of the parts was rejected. Then high-frequency dielectric heating of the material was tried and proved completely successful.

To avoid the necessity of making a special preform for the work, a small standard size was selected—five of these preforms, each weighing 0.1 lb., being used in each of the four mold cavities. Considerable handling of the preforms is eliminated and production speeded through the use of a metal tray instead of a loading board. The preforms are loaded on these trays in four rows, five preforms to each row. The operator then places the fixture in the oven. There the effect of the high-frequency alternating electrostatic field raises the temperature of the preforms to 270° F. in 73 sec., the heat being evenly distributed in the mass of the material. Because of the material's plasticity obtained with electronic preheating the phenolic flows easily and freely in the mold cavity, permitting the closing pressure to be reduced from 140 to 60 tons. The finished multi-circuit breakers were found to be free from defects and to have a high-gloss finish with a minimum of flash. Production was also greatly increased. The set-up in this molding plant whereby the 3-kw. heating unit was mounted on a dolly so it could be easily moved from press to press, also played a part in the speed-up.

The free flow condition of the plastic in the mold which was produced by this method of uniform through-heating of the preform permits the molding of a part which might otherwise be out of the question and the use of material otherwise impracticable. At the same time that production was speeded, reject percentages were substantially reduced and the need for expensive hand-finishing virtually removed. The use of high-frequency preheating made possible a lowering of the closing pressures which wear on the mold.

Credits—Material: Bakelite. Molded by Kuhn and Jacob Molding and Tool Co. Megatherm unit manufactured by Federal Telephone & Radio Corp.

* Vice-president and general manager, Kuhn & Jacob Molding & Tool Co.
† Engineer, Federal Telephone and Radio Corp.

PLASTICS IN REVIEW

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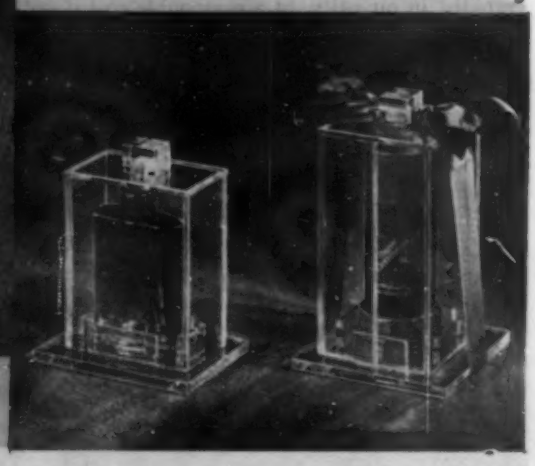

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1 Aristocrats of plastics creations are the Lucite and silver compacts fabricated by Elzac California Jewelry Creations. Entirely hand assembled, the compact has a lid of black methyl methacrylate to which is laminated the sterling silver design. The base is fabricated of transparent acrylic

2 Tired clocks can take cheer from the array of electric alarm clocks housed in Beetle which are making their appearance on sales counters. The housing, molded by Northern Industrial Chemical Co. and Plastics Divisions, General Electric Co., for Warren Telechron Co., is strong and abrasive resistant

3 Costume jewelry with a western air is designed by Jan de Swart for Victory Mfg. Company. Reproductions of large plastic carvings, the pins are molded of Tenite in a variety of colors. The 8-cavity molds are so constructed that the cavities can be interchanged. Thus, if one pin sells better than another, production of that item can be stepped up—the cavities for the poorer seller being replaced by those of the popular pin

4 Yarn Bob'n, product of Merit Mfg. Co., won't teach you to knit but it may relieve the headaches involved in knitting multi-colored socks and sweaters. Fabricated from Fibestos, Lumarith or Plastacele, each bobbin (sold in sets of ten) is wound with a separate color yarn which it releases with an even flow, without the annoyance of tangling

5 Crystal-clear containers for bottles of cologne, designed by Austin Suders for Atheley Bradford Co., are fabricated by hand from sheets of Lucite. To secure the bottle in place, small pieces of methyl methacrylate are cemented inside the container. Knobs on the tops of the containers are pieces of Lucite cemented together and cut to size. One design has a milled-out opening in the stopper through which a satin bow is slipped

6 Transparent to complement these mirrored switch plates which are manufactured by Haring Switch Plate Co., the Tenite screws are lighter than those of metal and are said to exert less pressure during installation. They are injection molded by Plastics Division, S. S. White Dental Mfg. Company

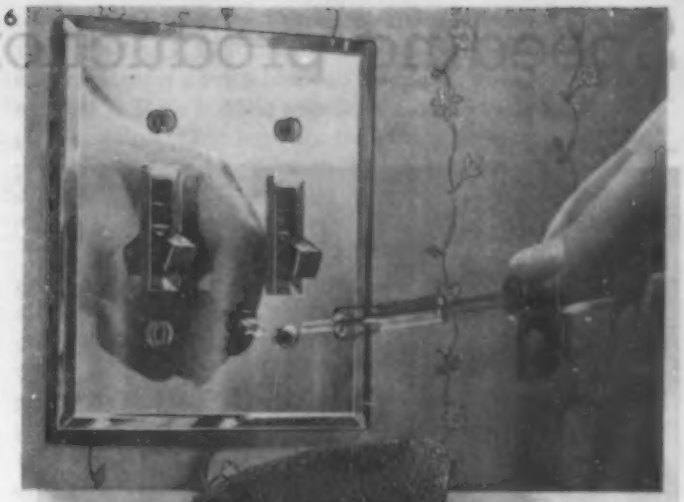
7 For hearts that are young and gay, Lilly Dache has created a hat which is hand woven of brilliant red Plexon and tied with a blue velvet bow in the back. The fabric is easily cleaned with a whisk of a damp cloth

8 Miniature motor armatures molded by Plastic Moldings Corp. depend upon one tenth of an ounce of Durez for their success. Nine separate copper inserts and a 1 3/4 in. shaft are molded together in one operation, the phenolic serving as bonding agent and insulating the parts from each other

9 Beauty at your finger tips—with the new La Cross manicure kit. Manufactured by Schnefel Bros. Corp., the set has nail care preparations fitted into four recesses in a base injection molded of Lumarith by Sterling Plastics Company. The base is produced in an automatic multiple cavity mold, emerging smooth and polished. Ridges above the beaded edge grip the cover

10 The drawing of a line parallel to a splined line was once an arduous task. Charles A. Jackson has designed for Jackson Instrument Co. a device consisting of a set of Plexiglas and aluminum rings in graduated sizes which provides for quicker and more accurate work. The desired curve is obtained by merely inserting the pencil point in the hole in the center of the disk and propelling the disk along the edge of the spline

6



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Speeding production of desalters

PHOTO, COURTESY PERMUTIT CO.

ON May 15, off Cape May, New Jersey, U-Boat 858 was formally surrendered to the U. S. Navy—the first enemy warship to give up to the United States after V-E Day. A dramatic climax to the campaign in the Atlantic, this surrender symbolized the end of vicious submarine warfare, the torpedoing of merchant vessels, machine-gunning of lifeboats and the struggles of survivors against starvation and thirst.

But these hazards still threaten shipwrecked sailors and airmen in the Pacific where the vast distances augment the problem of adequate provisions—particularly drinking water. Even before the Rickenbacker and Dixon-Aldrich-Pastula sagas brought home to the public the torture of thirst on the open seas, the Navy had been endeavoring to find a simple method of making seawater potable. Late in 1943 it was revealed that a "desalter" had been developed. In this process a special chemical in briquet form is used. When dropped into a tough, non-corroding water-tight plastic bag filled with seawater, this chemical quickly absorbs the dissolved salts, permitting them to be filtered out as the survivor sucks the water through a plastic tube.

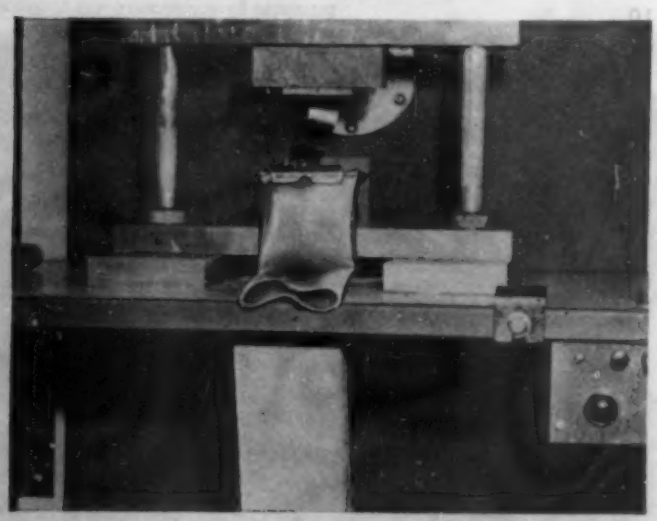
Each bag consists of 17 individual plastic parts which are formed from either flexible or rigid vinyl sheet, or injection molded from vinyl resin. The six molded parts include the filter ring, filter ring support, buckle, plug and two spout tube inserts. The body of the bag, the straps, reinforcing skirts and buckle-supporting strips are either die cut or blanked from sheet. Full directions for making drinking water are printed on each desalter bag.

In the two years since its introduction, this amazingly simple device has proved its effectiveness in action time and again. And as the demand for these desalters grew, it was necessary to increase production of its component parts.

One fabricator of the units met this challenge by the appli-

FIGS. 1 THROUGH 5, COURTESY GEMLOID CORP.

1 *The body of the desalter bag, one of 17 vinyl parts that comprise this unit, is formed from a sheet which is first stamped with directions for use*



2 *The bottom seam, like that on the side, is sealed by folding the sheet over a metal jig which acts as an electrode, then placing in a high-frequency unit*

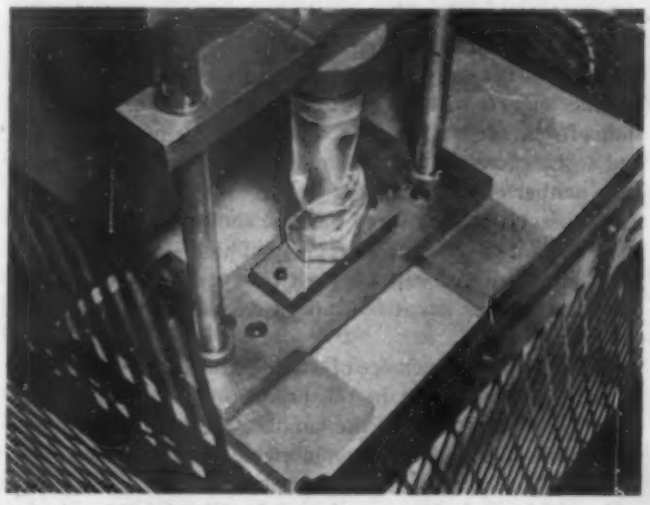
cation of radio-frequency power for rapid sealing of the individual units which make up the plastic bag. Special electronic sealing equipment was designed, and a mass-production set-up devised which makes possible the production of approximately 3000 bags per day on a two-shift set-up. Besides speeding production, the use of radio-frequency in this application also made unnecessary the use of solvents, which tend to impart to the material certain volatile odors that are harmful to taste and smell.

The first operation is the forming of the body of the bag from a flat vinyl sheet on which the required directions have been hand-stamped with a special aniline ink. The sheet is simply folded over a metal jig which acts as an electrode and then placed in the high-frequency powered machine where its edges are sealed together. All the other plastic parts are similarly attached, either fastened first with a solvent before being sealed, or held in position by clamps. A few of the component parts, such as the canvas filter and filter ring, the top buckle and strap, are subassembled separately for speed in handling, special jigs and fixtures being employed to hold them in position. All operations are automatically timed and range from 5 to 11 seconds. The longest is that in which the entire spout assembly is sealed to one end of the bag.

After each operation, there is careful inspection. When the entire bag is assembled, it is blown up with air and held under water for a few seconds to determine whether or not it will leak. If no bubbles appear, the bag is considered completely sealed. The bags are then hung on racks which are placed in an oven for 36 hr. at 130° F. to remove all residual solvents and make the bag as free as possible from taste or odor. After drying, the bags are inspected prior to shipment.

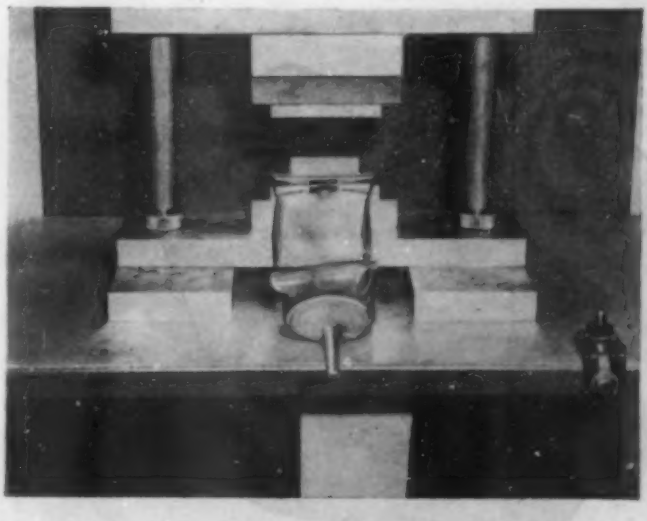
Not only has the application of the radio-frequency heating principle increased the output of these desalter bags but it has also made possible the production of an all-through weld that permanently fuses the two surfaces of the material where they are joined together. This same technique, for which patents have been applied for, has also been used by the company for the production of flotation bladders, and it is anticipated that it will be applied to the postwar production of thermoplastic consumer products such as shower curtains, aprons, bathing caps, suspenders, and other plasticized articles that require a bonding agent in their fabrication. Patents have already been applied for, both for the process and means of manufacture.

Credits—Material: Vinylite. Molded and fabricated by Gemloid Corp. for Permutit Co.



3 *The top of the desalination bag is also sealed through the use of a high-frequency heating unit*

4 *Such parts as the buckle and strap, canvas filter and ring are subassembled for speed in handl'ng*



5 *With all the component parts attached, the desalination unit is placed in a special jig for final assembly. All operations are automatically timed*

6 *Before the completed bags are hung in an oven to dry, they are filled with air and held under water. If no bubbles appear, the seal is satisfactory*

Fall bags with a shining future

HIGH style for fall are handbags made either of glossy vinyl sheeting or plastic coated yarn. Because quality bags must wear well and at the same time be adaptable to the current fashion, these plastic materials are away up in the front line of better bags. Not only do they blend with the soft silhouette dominant this season, but they offer a shining gleam to complement satin or contrast with the dull crepes and wools so popular for fall. The six handbags shown here are interesting for the indication they give of the many ways in which the plastic materials can be handled, enabling them to compete successfully with leathers and failles.

Very new are the high-gloss vinyl sheeting bags as shown by Josef (Fig. 5) and Bienen-Davis (Fig. 4) with their double wrist-length handles made of the same vinyl material and plastic frames designed to simulate tortoise shell.

Perhaps the outstanding characteristic of the plastic patent used in these bags is its ability to withstand continual flexing without cracking and crazing. Such resistance may be attributed to the fact that the material employs long chain or high molecular weight resins. This means that there are fewer chain ends to a given length. In consequence, the sheeting can withstand repeated bending without cracking.

The smoothness of the surface of the sheeting from which these bags are made is also said to have an effect on the longevity of the flex-life of the material. Because the resin is smoothly spread, there are no thin spots where bending stresses from flexing tend to concentrate.

One of the problems that had to be overcome in developing a high-gloss vinyl sheeting suitable for handbags was the tendency of the early materials to mar the finish on furniture or other objects with which it came in contact or to pick up stains itself. It is a question of which is the more annoying, and to be successful in the handbag field the sheeting must have neither of these failings.

Manufacturers discovered that the choice of plasticizer had an important effect on this property of high-gloss vinyl sheeting. In addition, unsuitable plasticizer tended to ooze slowly to the surface, or sweat out, and leave the sheeting through evaporation.

But more than the choice of suitable resins and satisfactory plasticizers is involved in the production of plastic patent which meets the needs of the handbag market. Such minor ingredients as pigments, fillers, lubricants and stabilizers must be carefully selected. If, for example, too much or too cheap a pigment is used, the strength and flex life of the sheeting as well as other properties are adversely affected.

Flexible vinyl sheeting for bags—and for shoes and accessories—must possess many other properties if it is to prove satisfactory. Most important is the ability of the material to retain its look and feel at temperatures varying from −10 to 130° F., for this means that high-gloss bags can be high style regardless of the season. Hitherto, such handbags were barred from the winter scene because of the tendency of patent leathers to crack in cold weather. Then, too, the sheeting must not stick to itself and become too soft at room and higher temperatures. Further, the material should not be combustible nor highly flammable, and should be capable of being manufactured by standard factory methods.

Some very novel bag effects have been achieved using plastic coated yarn. This material differs from solidly extruded plastic yarns in that it employs a standard fiber—very often a rayon fiber—as a base or support. Because of this construction, plastic coated yarns will remain as constant as the fiber used in the inner core. This factor eliminates loom problems since the yarns do not become soft and expand in warm weather nor get brittle in cold weather and contract.

The bags shown in Figs. 1, 2, 3 and 6 exemplify the variety of finishes in which plastic-covered yarns can be manufactured. Take, for example, the little draw-string pouch by Harry Rosenfeld (Fig 1) of plastic-coated thread knitted in a hunter's knot over a core of black woolen yarn and then hand-fashioned into a widely spaced knotted fabric showing the lining underneath. The wrist-length handle is made up of the same thin knotted cord. In this handbag the yarn is shining bright, but the coated fibers can just as well be produced with a dull finish or with transparent or opaque coating.

Woven, knitted, braided, plaited, hand-knitted and crocheted—the plastic coated yarn can be made up into handbags using any or all of these methods. Typical of the effects to be achieved by hand crocheting is the underarm bag presented by Jana (Fig. 6). Here the treatment of the yarns suggests the elaborate art needlework of the past.

The handworked Cordera that is used in the Josef handbag shown in Fig. 3 is not only at ease in the dress-up world, but it is also extremely practical. The material can easily be kept clean, as can all the fabrics woven of plastic-coated yarn, simply by washing with a damp cloth. Moreover, this yarn is highly resistant to prespiration, water, oil, mild acids, grease and alcohol. As can be seen, the material works very easily and can even be fashioned into such difficult shapes as presented by this boxy silhouette.

Not all of these yarns are hand-worked, however. Strikingly intricate patterns such as that of the Zelman bateau bag (Fig. 2) are evolved on the broadloom. Using machines, it is possible to obtain petit-point weaves which approach pin-point morocco in appearance.

As the fall season gets under way, plastics may be expected to get an even more secure hold on the handbag market. At the moment glossy vinyl sheeting and plastic-coated yarn stand high in the fashion picture. Their ranks may yet be augmented by other plastic materials.

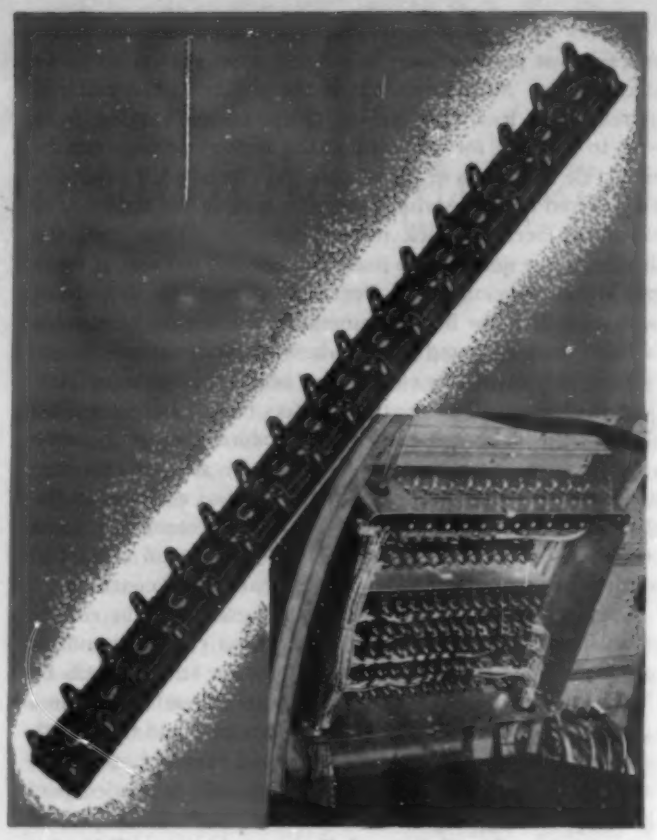
Credits—Materials: Vinylite, Plexon. Suppliers of bag fabrics: plastic patent, Hermann Loewenstein; plastic-coated yarn, Merlang Mfg. Co. Bag Manufacturers: Bienen-Davis, Inc., Jana Bag Co., Josef of Gold Seal Importers, Inc., Harry Rosenfeld Co., Zelman Bag Co.

A SAVING OF OUNCES OF WEIGHT IN THE TERminal panels of a plane may seem like penny saving in a mint when the giant transports with their multitudinous components are viewed in flight. But it is attention to weight saving on such details as this which results in the plane's ability to carry huge quantities of supplies for great distances.

Producers of the C-82 Packet, known as the "flying box car," have incorporated phenolic terminal panels in the mechanism of their new sky giant, effecting one such type of saving. These panels, which form part of the electrical system of the C-82, are mounted in two terminal boxes in the main pilot compartment. They provide firm anchorage and support for the poles to which radio, light and instrument wires are connected.

The terminal panel is of intricate design, with a double row of 17 tapered bosses on one side, and 33 holes for connections and assembly in the center. The larger holes are produced with a recessed hexagonal shoulder and open into a rectangular recess on the back of the panel. The small holes are beveled on the reverse side of the panel. Panels are compression molded in two 2-cavity molds which are operated on one press as a 4-cavity unit. With this type of production, the parts can be turned out at the rate of approximately 1000 a day. Finishing operations on the piece consist of the removal of the burr at the parting line and around the 33 holes in the design.

Credits—Material: Bakelite. Molded by American Insulator Corp. for Aircraft Div., Fairchild Engine and Airplane Corp.



Plastics

PRESENT-DAY DAIRIES, WITH THEIR UP-TO-DATE mechanized milking equipment, bear little resemblance to the popular conception of the pretty milkmaid laboring over a line of patient bossies. Busy farmers with large herds of cows which must be handled each day welcome every new device that lightens their tasks and makes them cleaner and more economical. Portable mechanical milkers capable of milking a number of cows at one time have, therefore, a wide popularity among dairy farmers.

These milking machines employ plastics for several of their more important functions, one particular unit having a valve cup, teat cups and claw of these materials. In this instance plastics were chosen because they simplified the mechanism and materially increased production, besides being easier to clean, an important factor in dairy maintenance.

The valve cup, which is considered the heart of the milker, fits over the bulk container. It is injection molded of transparent polystyrene in a one-cavity die. Phenolics were previously employed in the manufacture of this part but the polystyrene is preferred because it permits the operator to see at every stroke of the pump how much milk the cow is giving and when it is finished. The teat cups and the claw—the latter part making the connection between the machine and the forward teats of the cow—are injection molded of ethyl cellulose in a two-cavity die. These last-mentioned parts are produced in red, amber or black.

Credits—Materials: Valve cup, Styron; teat cups and claw, Ethocel. Molded by Anfinsen Plastic Molding for Nat. Milker Co.

COLORFUL BEACH AND BATHROOM CLOGS, WHICH are cleverly designed to take full advantage of streamlining, provide another effective example of the ever-widening application of plastics to the current footwear line. These light and comfortable "clodhoppers" have a smooth and non-splintering surface and the natural warmth of the plastic material is especially attractive to the touch. Ultimately they will be available in a wide selection of colors. Under present wartime restrictions, however, only the more popular colors are used. The color is integral in the material, hence is impervious to chipping and peeling.

The slippers are injection molded of cellulose acetate and cellulose acetate butyrate in a standard shoe size. Adjustment to various foot measurements is effected by means of a broad strap which fits over the instep. The mold for these clogs was designed with due allowance provided for shrinkage. As the pieces come from the press they are polished and matched up for size. Heel and arch are molded to conform to the shape of the foot, and the rocker-type bottom is provided with a ribbed construction designed to prevent slipping on wet floors. The clogs are gated in the sides rather than in the center.

Since the material is washable, and has lower moisture absorption than the material usually employed in the construction of this type of slipper, the likelihood of athlete's foot and similar foot infections is lessened.

Credits—Material: Lumarith and Tenite II. Molded by Elmer E. Mills Corp. for The Metropolitan Line

Products*

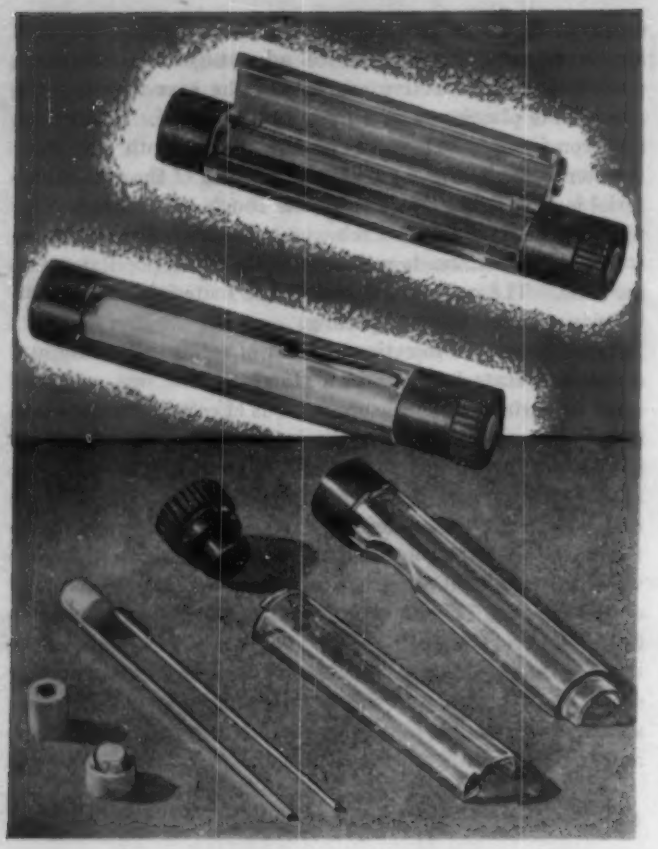
THE DIFFICULT AND ALMOST IMPASSABLE TERrain of the Pacific war theater has made the transportation of litter-borne patients a hazardous task both for the casualty and the medical corpsmen. The wounded have to be evacuated over cliffs and down hillside trails where a rigid litter could not be utilized. Ponchos were used as an emergency measure until a slinglike canvas stretcher was improvised during the New Georgia campaign.

Having decided that a lighter material would be more suitable, a Navy pharmacist's mate devised a litter which he submitted to the Bureau of Medicine and Surgery of the U. S. Navy. After experimentation it was approved, perfected and manufactured in time for the Okinawa campaign.

Known as the MFRL, the present stretcher is a non-rigid fabric litter of 6.89 oz. nylon. It incorporates snaps for attachment of a poncho as a cover sheet, slings and crotch straps for the hoisting and lowering of a casualty over steep embankments, six reinforced cloth loops for carrying straps and overlapping hems for insertion of poles if desired. The litter weighs only 2 lb. 5 oz. but has been found durable and adaptable to all types of terrain and methods of carry, varying from a one-man drag to a six-man carry. It is easily maintained in a sanitary condition. A sample litter supported over 800 lb. without breaking.

Credits—Material: Nylon. Designed by Chief Pharmacist's Mate John A. Gallagher, U.S.N.R., for the U. S. Marine Corp. and developed by Medical Field Research Laboratory

* Reg. U. S. Patent Office.



THE FINE ART OF ROLLING A CIGARETTE—ONCE the special accomplishment of an initiated few—has, with the current cigarette shortage, become almost a universal pastime. Novices at fixing the makings are materially aided by a small machine, selling for a dollar, known as the Cig-roll-ett.

Requiring but a few seconds to produce a finished cigarette, the apparatus consists of a transparent acrylic barrel, thinned at the ends to fit inside two molded grooved end caps. A hinged cover on the barrel, which operates on pins, lifts to disclose a center 2-forked wire. The plug which supports the left end of this wire turns inside the left end cap. The right end support plug, a sealing plug and the turning knob, cemented in a unit assembly, fit inside the right hand end cap.

The barrel is filled with loose tobacco and the lid closed. Then the fork is revolved inside the barrel to "form" the tobacco. The lid is opened to permit the edges of the paper to be inserted, gummed side up. It is again closed and the knob revolved until almost all the paper is drawn in. The back of the paper is moistened and the rolling completed.

The body of the roller and hinged barrel cover are injection molded of methyl methacrylate, several units at a cycle. The other parts of the assembly—end cap, left end support plug, unit assembly consisting of the wire support plug, sealing plug and center turning knob, and a right-hand end cap into which the assembly fits—are also injection molded, using cellulose acetate.

Credits—Materials: Lucite and Plastacele. Molded by Modern Plastics Corp. for Plastico.

Plastics

WITH THE EMERGENCE OF COLOR PHOTOGRAPHY as a national hobby, slide viewers have achieved a concomitant popularity. These instruments for the magnification of the small color transparencies, which enable the user to enjoy the fine detail of the films, are now being produced in an inexpensive format.

The viewers feature a two-lens optical system. The viewing lens is set at a convenient angle and is not affected by outside light sources. The lens, rectangular in shape, is also corrected to practically eliminate distortion. A simple feeding system provides for automatic compensation for variations in the thickness of slides and will accommodate paper-mounted, metal or glass bound transparencies. These viewers are completely self-contained and operate on a 110-volt AC or DC current or by means of a battery. The base is provided with small tabs to prevent the unit from marring polished surfaces.

There were several reasons for the selection of a general purpose phenolic for this instrument. Most important was its unusual shape with compound curvatures which would have been difficult to reproduce in metal. Then, too, the natural gloss of the plastic material eliminated the need for painting and polishing. And there was no danger of the phenolic chipping and peeling.

The streamlined outer case, the mask, the track transport and mounting plate are compression molded in two-cavity dies. The switch control is transfer-molded in a six-cavity hobbed die.

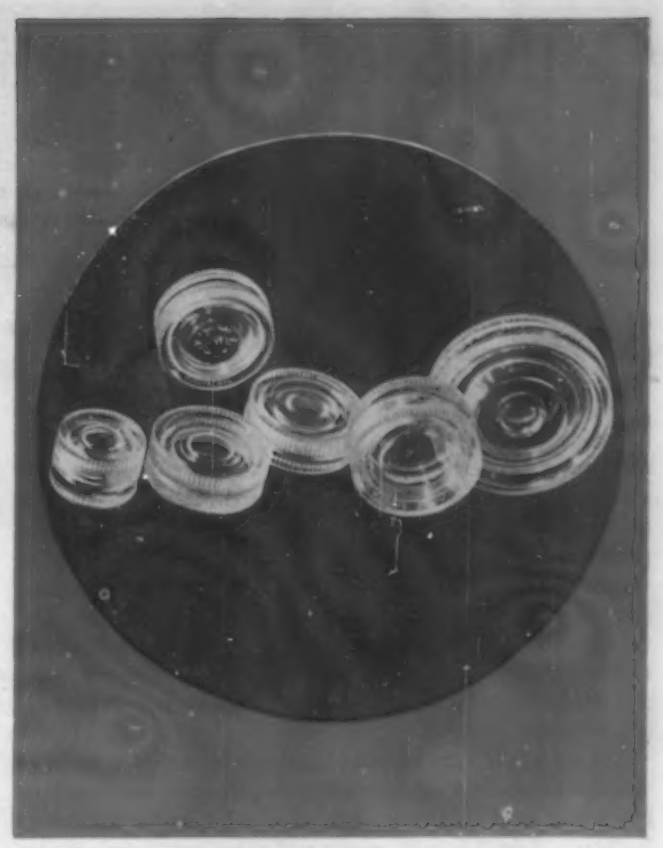
Credits—Material: Durez. Molded by Reinhold-Geiger Plastics for Adel Precision Products Corp.

EFFECTIVENESS OF THE NORDEN BOMBSIGHT—amply demonstrated in the devastated ruins of German and Japanese war plants—lies almost as much in the proper packaging of its delicate parts as in its initial manufacture. Its slightest deviation from perfection may mean the difference between the failure and the complete success of a mission. The critical precision bearings for this instrument—which approach the most precise tolerance requirements in the industry—must be packed in boxes which possess conspicuous qualities of strength, and weather and wear resistance to assure maintenance of accuracy.

Containers fabricated from clear methyl methacrylate were found the ideal packaging medium for these parts because of their resistance to a wide range of temperatures and moisture, their imperviousness to the oil in which the bearings are packed as well as their strength and light weight.

These screw type boxes, produced in six sizes, are injection molded, twelve at a time, in two parts which have matching threads. Threads on each half, which are obtained by means of special inserts used in the molding process, are held to extremely close tolerances in order to provide a tight seal when the two halves are joined. Each box is designed to hold one bearing, which is shipped ready for installation in the bombsight. For overseas shipment, additional protection is provided for the parts by means of a neoprene gasket which serves as a seal on the boxes.

Credits—Material: Lucite. Molded by Plastic Molding Corp. or Barden Corp., Div. Carl L. Norden Corp.



Products*

TROOPS IN THE PACIFIC ARE NOW CARRYING their essential machetes—those long, heavy, all-purpose knives so vital in jungle warfare—in plastic sheaths. Now in quantity production and being shipped out to fighting men as rapidly as they can be produced, the sheaths replace those of canvas and leather. They were adopted as Army "standard" because of their waterproofness, fungus resistance and general durability. Rigorous tests show that they will outlast other sheaths and will not mildew.

These sheaths are compression molded from polyvinyl butyral coated duck. The heavy chaffer duck is first coated in its full width—which is usually 60 in.—with the polyvinyl butyral which is calendered to the fabric. The coated duck is then cut to shape and two pieces joined together over a mandrel which permits them to be compression molded in one piece with a space between the sides to accommodate the blade. A multi-cavity mold is used in the process. The sheath is finished off with a metal mouthpiece of corrosion-resistant steel and is fitted inside with a phosphor-bronze spring to hold the machete securely when sheathed. A hook permits attachment to the soldier's belt.

While the machete is primarily a jungle weapon, it is used in other climates, a factor which caused developers of the sheath to write specifications assuring its flexibility in a wide range of temperatures. Accordingly, the plastics were so applied that the sheath is flexible to 0° F.

Credits—Material: Monsanto vinyl butyral. Molded by Victory Plastics Co. and J-D Leather Products for U. S. Army

* Reg. U. S. Patent Office.

Cellulose lacquer film-type finishes

by W. E. MUNN*

The number and variety of natural or artificial surfaces that can be accurately reproduced in color on cellulose nitrate base film suggests endless postwar applications for these transfer-type finishes in the home and the office

THE time is fast approaching when wishful thoughts of building and redecorating—the house, the office, all types of public buildings—will be translated into action. When that time arrives the number and variety of finishes available as covering for walls and furniture will once more be augmented by cellulose lacquer film-type transfers which accurately reproduce any natural or artificial surface. This film which was developed in our laboratories in 1938 has, since the outbreak of the war, been completely devoted to war applications During this period, however, our technicians have been investigating new uses for the material. Developments stemming from this activity and others worked out to meet the requirements of the Armed Services should make possible increased use of these finishes in a variety of postwar applications.

Our subject library includes hundreds of perfect samples of finished woods from amboyna to zebrawood, of marbles from black and gold to Brech opal, of laced rawhide and other leathers. Tile, Lauhalla weave and other novel surfaces are also included in the catalog.

* Director of Technical Div., The Di-Noc Co.

The color camera and photographic process

In producing a cellulose lacquer film-type finish, the original subject is first photographed in color, using what is reported to be the world's largest color separation camera. To make the several plates required for color printing and achieve the accurate register necessary for satisfactory reproduction on the nitrocellulose film base, it was found that the entire camera had to have a special synthetic rubber mounting. Without such a buffer, the vibration of other machinery in the factory was transmitted directly to the body of the camera. Mounted on rollers on a track 30 ft. long, this camera will enlarge a subject three to one because of the unusually long (20 ft.) bellows draw. The entire unit is over 50 ft. long—so big that an area 5 ft. sq. can be photographed actual size. The equipment occupies two large studio-type rooms in our laboratories and the bellows are of such a size that they could easily accommodate a big man seated in an easy chair. The lens is an imported Carl Zeiss color-corrective lens, 4 in. in diameter, which operates at stops ranging from F. 11 to F. 90.

Such effects as the solid elegance of marble doors, combined with the simple dignity of a grained finish for wall tables, indicate possible uses of film type finishes

Satin finish wall papers are natural media for the film in intimate galleries. Here, again, the palette table reflects the reproductive accuracy of the process

ALL PHOTOS, COURTESY THE DI-NOC CO.

The appearance of this room is enhanced by the fine finish of the buffet, achieved by the application of cellulose nitrate film reproducing rare wood and other quality finishes. Snakeskin trim on mirror and table add a novel touch

The master sample to be reproduced is mounted on a vacuum board to assure absolute flatness, and brilliantly illuminated by four powerful 90-amp. arcs. The lens and master sample occupy one studio. The other room is designed to facilitate loading the plates in the camera. After the color plates are made and the designs etched on copper plates for printing purposes, the synthetic resin base film is printed using special permanent printing colors which will maintain the brilliance and depth of the original. This film is prepared for the printing operation from a lustrous nitrocellulose base, which is processed to a supporting transfer paper. When finished the printed cellulose nitrate base film is cut into sheets of the specified size.

In reality the method of reproduction is a gravure process known as intaglio printing. The multiple colors penetrate the nitrocellulose film to various depths so that it is actually engraved. This gives the reproductions an appearance of third dimension, or depth, so realistic it is difficult to distinguish the finished film from the original material after it has been applied.

Attaching the film

Most persons are familiar with the old style decalcomanias where a printed paper or film is moistened and slipped off the backing onto a smooth surface. In this type of transfer the subject is held only by the adhesion inherent in the water soluble gum that serves to separate the backing paper from the attached printed matter. The design is removed without difficulty by prewetting.

With these cellulose lacquer film-type finishes, however, a newer and more permanent method of fastening the film to the surface has been developed. The surface—metal, veneer, wood, pressed board, or other smooth surfaced material—is first coated with a lacquer, or synthetic surfacer coat, which is in itself a type of finish. This special base lacquer is receptive to the same solvent as the decorative film. When the film is to be applied to the lacquered surface, the film and the base finish are both first wetted with the special mutual solvent. Thus when the film is finally laminated onto the surface, the mutual solvent permanently fuses it with the base lacquer previously applied. The paper backing of the decorative film is stripped from the outer surface immediately after application.

The bond between the film and the base material is so effective that, in the case of metal parts, subsequent drawing operations to a depth of as much as 5 in. have been performed without injury to the film. The graining on automotive dashboards, glove compartments and ash trays in many prewar cars was applied in this fashion. In fact, approximately 75 percent of all prewar cars featured some application of this type of film. This use of the films was really just getting underway when the more immediate and essential demands

Marble finished mirrors and radiator housings, reflecting all of the beauty of the material which they simulate, complement the decor of a fashionable salon

of war caused the abrupt cessation of all automobile production for civilian use.

As it is used for war

And how have these nitrocellulose base films been used during the war period? Probably their most remarkable and extensive military application has been in the field of aircraft insignia. Thousands of man-hours have been saved in production and field repairs have been materially expedited by the use of the nitrocellulose film for aircraft insignia. Supplied in compact kits with special squeegees to apply the film over rivet heads, the insignia are complete and easily applied. Our company technicians perfected a special mutual solvent for the approved lacquers applied to our war planes and the transfer film. When the lacquer and the film are moistened with the solvent and the insignia pressed into place, the two fuse together so as to withstand all Army and Navy tests. For example, this film transfer withstood the salt spray test satisfactorily for 250 hours. While the insignia are generally supplied in a dull non-reflective eggshell finish, almost any type of surface is available, from non-specular to glossy.

These transfers have also been used to expedite lettering of control panels, escape hatch handles, valves and other controls where the specifications are too rigid for ordinary transfers and hand lettering is too slow for the amount of identification necessary.

Of interest to civilians

The automotive, the radio, the vending machine, furniture and interior wallboard industries all made extensive use of these finishes before the war. And today plans are being laid to increase its uses substantially in all of these fields. Part of the appeal of this cellulose nitrate base film is its low cost, part, its eye appeal.

Present indications are that more grained and fancy interiors will be employed in postwar cars. As for the radio industry, the price of real wood quality veneer makes its use in any but the more expensive units almost prohibitive. However, radio cabinets and automatic record players made of less expensive veneers or other types of bonded or pressed board are now being surfaced with reproductions of the most expensive and rare veneers. Thus this cellulose lacquer film-type finish helps to bring the more attractive materials within the popular price ranges. In other instances molded plastic radios are being coated with this film. In this way a contrasting inlay is provided.

The use of these films on vending machines and in the design of various record players, dispensing machines, cash registers, adding machines, lockers, office files, cabinets, etc., eliminates many expensive finishing, baking, polishing and painting operations. These industries were using these tough easily cleaned films on an increasing scale when war demands halted production.

In the furniture and interior decorating fields, the finishes have met with instantaneous successes. Many prominent department stores and interior decorators have featured or are planning to feature interiors employing these decorative films. The stores themselves are using the printed nitrocellulose sheets to cover counters, display cases and window display backgrounds. Beds, tables, dressers, and other types of furniture finished with the films have been accepted by the best stores; they will be available as soon as the manpower situation eases and the expected postwar building boom and civilian production begins.

The cellulose lacquer film-type materials will also be available in standard sections on various types of prefabricated boards. All the user will have to do is saw the board to fit at the time of installation. The field for fancy decorated wall boards in commercial offices alone is a vast one which has been barely exploited to date, and there is the housing field in addition. The numbers of materials which may be covered with this finish is constantly growing and include any smooth finished base material which is impervious to moisture. It is anticipated that panels, with the printed film in position, will soon be obtainable from building suppliers. This should eliminate the need for subsequent painting and finishing. The application of the film to signs, displays and to other tools of the advertising industry is also going to be extensive.

The fact that these films may be easily cleaned by washing and are moisture resistant suggests their application in bathrooms and kitchens. Since they are permanently fused by the mutual solvent to the base lacquer, there is no danger of their peeling or crazing when applied on metals or other materials. The finish actually expands and shrinks with the metal or surface to which it is applied.

In a variation of the material, widely used in the movie industry, a lacquer type film is permanently attached to a paper backing. Available in triple rolls 15$^{3}/_{4}$ yd. long and 32 in. wide, this product is applied like ordinary wallpaper, is washable and lightfast.

In a world where the demand for natural and perfect building materials may soon challenge nature's supply and where labor costs are becoming a paramount factor, these plastic films offer the designer unlimited range of materials at a fraction of their original cost. In addition, they permit their installation in a portion of the time formerly needed since no finishing operations are required.

Credits—Material: Di-Noc

PLASTICS*
Engineering Section
F. B. STANLEY, Editor

Molded ogives for Navy projectiles

FOR the past several years, the plastics industry has been doing yeoman service in furnishing the M-52 fuze to the Army. The fuze, used for detonating purposes on mortar shells, is probably, as far as the tonnage is concerned, the largest plastics item presently supplied to the Armed Services. Well-deserved publicity has been given this job, and articles on production methods have appeared in trade magazines.

Recently, however, the Navy has been quietly developing and producing a new part—a plastic ogive—with uses similar to those of the M-52. This piece functions as a component of point detonating fuzes for various types of Naval projectiles. While not as complex as the M-52 fuze, the ogive is designed with several dimensions which must be held to close tolerances. It was developed and engineered by the Bureau of Ordnance and Naval Ordnance Laboratory, Silver Spring. According to indications, this item bids fair to become one of the more important war jobs of the molding industry.

The ogive did not, of course, go into production without the various trials and tribulations which are usual in such developments. For example, one of the prime requisites was that helmet liner scrap be used as the base material for the MK 30 if it were at all possible. This restriction on material made the molding problems more difficult than they would have been if virgin material had been available. Two sizes of ogives were needed by the Navy, one—the MK 29—for the larger caliber shells and the other—the MK 30—for the smaller shells and rockets. The MK 29 ogive could not be produced satisfactorily from scrap, so impregnated cloth rolled into coil charges was adopted for these parts.

With the major material problems decided, production became the paramount issue. The stock of the helmet liner scrap which is used for the MK 30 ogives is 8- or 12-oz. duck impregnated with a phenolic resin. It is deep olive green, a color which intensifies as the ogive is manufactured.

Transfer molding the MK 30

When a Boston molding company first attempted to produce the MK 30, using 4-cavity transfer molds, a great deal of resin segregation was encountered in the thin section which is located at the nose of the molded piece. So thin was this section that very little, if any, of the finely chopped canvas scrap managed to find its way into the portion of the mold forming this part of the ogive. Instead, this section filled up with phenolic resin squeezed out of the material filling the rest of the mold. The result was an ogive which was very weak at the large diameter.

The problem was handled in the following manner. Four $^1/_2$-in. disks of virgin material with holes in their centers were assembled on the force plug in each cavity. Next, a round preform weighing about 33 gm. was placed on the point of the force plug. The balance of the material, which approximates 415 gm. of loose shredded stock, was then loaded in the

1—Navy ogives are molded of phenolic resin impregnated helmet liner scrap or impregnated cotton rolled into coil charges. 2—One company that transfer molded the job had difficulty because of resin segregation. This was overcome by using a combination of transfer and compression molding. A preform of shredded stock and 3 disks were placed in the mold before the bulk of the scrap was loaded in the transfer pot

1 PHOTOS 1, 2 AND 3, COURTESY NORTHERN INDUSTRIAL CHEMICAL CO.

2

* Reg. U.S. Patent Office

3—This pile of helmet liner scrap, the amount required for a shot of 4 ogives, illustrates the very high bulk factor of the loose material. The single preform and the 4 disks which are used for the molding of each ogive weigh 33 and 13 gm., respectively

FIGS. 4 THROUGH 6, COURTESY FAIRBORN PRODUCTS, INC.

4—At another company, the ogives are compression molded. Here, preparatory to preforming the phenolic impregnated helmet liner scrap, the material is carefully weighed out in square grill work pans, then heated in an oven

transfer pot. It is apparent that the operation had become a combination of compression and transfer molding, although actually very little flow was encountered in the cavity before the transfer operation took place. Operating in this manner, the thin section of the ogive was filled out with canvas material and most problems of resin segregation were eliminated.

In this plant, the 4-cavity setup was handled with a single transfer pot feeding into four separate sprues. The undercuts in the transfer plunger were sufficient to remove positively 100 percent of the cull from each shot. But in some cases the cured sprues did not possess sufficient strength with the result that they sometimes broke off in the sprue holes, plugging them up. Consequently, after the molds were completely opened, the operator had to inspect the cavities to ascertain whether or not any of the sprue holes were plugged.

All sorts of tricks were experimented with in an effort to clear up these plugged holes quickly. Finally one of the executives of this company suggested that a sprue hole cleaner be molded from the material used for the ogives. To make this cleaner, long brass pins were machined to a diameter slightly smaller than the diameter of the sprue holes so that they could pass completely through each hole. One end of each of these pins was made with a diameter larger than the other end. This large section was then undercut and knurled.

When completed, the four pins were assembled in the sprue holes with the undercut and knurled ends projecting upward into the transfer pot. A load of helmet liner scrap was then placed in the pot and pressure applied to it by closing the mold, an action which forced the material up against the transfer plunger. Inasmuch as the sprue holes were plugged by the four brass pins, no transfer action took place. Material was compression molded in the transfer pot with the transfer pot acting as a cavity and the plunger acting as a force plug. The four pins thereby became inserts and were molded directly into the disk. The material completely filled out in the undercut portion of the transfer plunger so that when the mold, transfer pot and plunger were opened, the disk complete with four molded pins was withdrawn from the transfer pot.

Since the undercut of the transfer plunger is symmetrically machined across its entire face, it is possible, by pushing against the cull, to slide this whole piece from front to back. Thus, at the completion of a molding cycle the cull can be slipped easily from the transfer plunger and replaced by the cleaning fixture whose construction has just been described. With this arrangement there is no question of the brass rods, which have been molded into the cleaner, matching with the sprue holes they are designed to fit. Consequently, when the mold closes with the cleaning fixture in place the 4 molded-in rods automatically push out any sprue which has broken off the shot and lodged in the sprue hole. This arrangement gave the molder a perfect cleaning fixture at little cost.

A comparison of preforms and bulk material

Figure 3 shows a complete charge of the loose material for one shot (4 ogives) and the four disks and one preform which are used in each cavity. Some idea of the bulk factor of this material can be obtained by considering the size of the

preform and the bulk material shown in Fig. 3 in relation to the following weights:

Four disks together weigh 13 grams.

One preform weighs 33 grams.

Loose material weighs 415 grams.

An interesting unit was set up by this Boston molder for production of preforms. A press[1] capable of delivering 4 tons of pressure in repeated up and down strokes made possible the rough cold preforming of this helmet liner scrap. Being self-contained, this bench-type machine was a very handy adjunct to this job which had a total cycle of approximately 10 min. with a 6 min. curing. No use was made of any preheating equipment of any type.

Very little finishing work is done on these ogives beyond removal of the gate and machining of the counter-bore to exact size. It is also necessary to machine the parts to length since tolerances on this dimension are very close. Another important dimension relates to the concentricity of the center hole with the counter-bore of the nose which must be, as the molder states, "concentric." An idea of some of the tolerances may be gained from the dimensions of 0.945 in. with ±0.005 in. tolerance, and 0.570 minimum to 0.575 maximum.

Preforms for the MK 30

Because of the very high bulk factor of the helmet liner scrap, all companies engaged in the compression molding of the MK 30 found it necessary to preform the scrap material before molding. Three very important conditions had to be met: 1) It was essential that the preforms be made from a very accurately weighed charge, 2) that the preforms be of

[1] Dennison Multipress.

5—After being heated to a temperature of 220° F., the scrap, which is still on the grilled pans, is removed from the oven. It is then rolled into a rough bundle ready for the preformer which is shown at the extreme right

7—When the forming ram is withdrawn from the preform die, a pusher pin kicks the preform out of the mold and into a chute which feeds a large bin. Empty material trays are returned to the loading and weighing tables in another chute. Two weighers and one preform operator make a crew

6—The semi-automatic preform mold is mounted on runners so that it can be pulled forward from beneath the ram to facilitate loading. Filled, the mold is pushed back under the air-actuated ram which compresses the scrap into preforms of the desired shape and compactness

sufficient density so the mold loading operation will be simple, and 3) that preforms be made in such a manner as to preclude the possibility of falling apart during handling and shipment.

As carried out by a Detroit company supplying preforms for the molding of the MK 30 ogive, the first step in the forming of the preform involves the accurate weighing of the scrap. So exact are these weight requirements that a total net weight of 87 gm., a variance only of ±3 gm., is permitted. In other preforms the tolerance is lower. This accurate weight is of prime importance when the final molding operation begins since one over-weight preform will spoil an entire shot. If the preform is too light the molded part will not come up to the final tolerances demanded.

After the scrap is weighed out in grill work containers, these trays are thrust into an oven where a temperature of 220° F. is maintained. As the pans emerge from the heating oven (Fig. 5) the scrap material is rolled by hand and stuffed into a mold (Fig. 6) which is mounted on rails so it can be pulled forward by hand from beneath the ram.

As soon as the mold has been placed in position for preforming, the operator activates an air cylinder which functions on a line pressure of 75 p.s.i. When the preforming is complete and the ram pressure on the preform mold released, a compensating ram ejects the preform from the mold.

In the meantime, the empty pan in which the scrap was preheated is placed in a slanting chute and is returned to the loading table for refills. Operation is simple and fast. The crews consist of three operators—two for loading and one for forming. Production ranges around 200 preforms an hour.

When delivered to an Indiana molder, these preforms are used to mold the MK 30 ogives in units of 5 molds each in a two-deck press. Each mold cavity is first charged with 8 gm. of finely macerated material which will form the tip of the mold piece. A die-cut skirt of impregnated cloth is then wrapped around the preform and dropped into the mold cavity. On top of all this material is placed a die-cut circle of impregnated cloth which has a hole in its center.

Experience at this plant has shown that it takes approximately 1 min. to load one cavity—5 min. to load a fixture. The loading tables are adjacent to the press and it is a quick and easy job to transfer the molds to the platens. The alternate opening of the press to permit the insertion of fixtures, now in the top and now the bottom deck of the press, has the advantage of permitting the ogives which are in the process of molding to "breathe," thus eliminating a separate operation.

The effect of this system of loading is to produce continuous operation with a 15-min. molding cycle. The press operates with a pressure of approximately 1900 p.s.i. on a 16-in. ram. A temperature of 325° F. is held during the molding process.

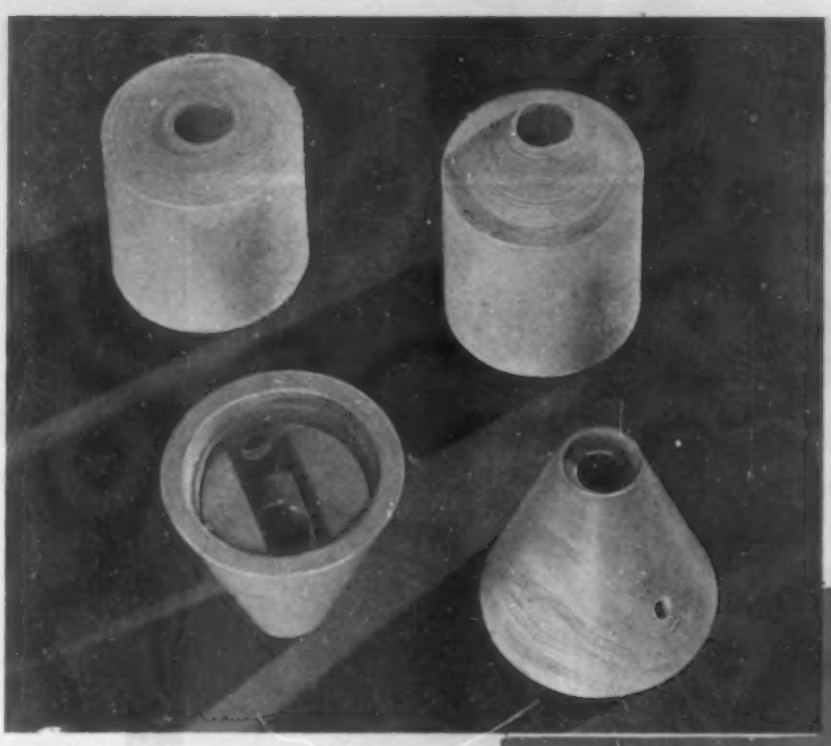
Coil charges for the MK 29

The preparation of the preform for the MK 29 ogive is entirely different for in this case virgin material is employed rather than helmet liner scrap. The Detroit company whose MK 30 preforms we have just described also makes coil charges for the larger ogive. The new stock used in this work comes in the form of narrow rolls about 30 in. across and 3 in. wide. The width could be altered if specifications should be changed. A strip of canvas is wound on a bobbin which has a space limit trip that operates when the desired amount of material has been rolled up (Fig. 8). When the winding is finished, the operator gages the roll and, if satisfied, cuts the tape by hand and passes it to the packing crew. The end of the roll is lightly sealed and the rolls put edgewise in wooden cradles which hold them in place and prevent unwinding.

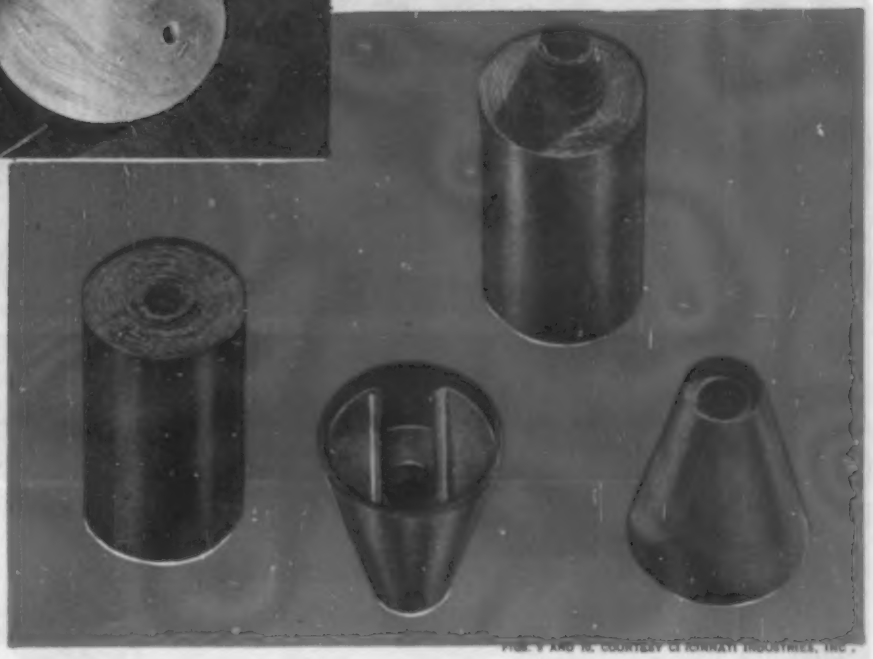
The molding of the MK 29 ogives is similar to that of the MK 30 except that only four pieces are molded in each fixture instead of five. The reduction in capacity is due to the necessity for removing pins in the side holes.

Finishing the ogives—both the MK 29 and the MK 30—is accomplished at an Indiana molding plant engaged in this work through the use of several new machines and the ingenious application of a number of old units. The flash ring at the base of each ogive is removed by a punch press, a

8—Coil charges of impregnated cotton duck are also used to mold these ogives. The tape is wound from the roll in the background onto a bobbin having a limit switch that automatically stops the winding when the roll is the correct size. The tape is then cut and the roll weighed before being stacked for shipment



9—*MK 29 ogives molded from resin impregnated creped cloth, continuously laminated throughout. (Upper left) a coil charge of the impregnated cloth as it is shipped. (Upper right) the same coil as it is telescoped by the molder*



10—*Ogives, known as the MK 30, for smaller rockets and shells, are molded from resin treated creped cloth by the same process as is followed in the production of the MK 29. (Lower right) interior and exterior views of the completed ogive*

FIGS. 9 AND 10, COURTESY OF CINCINNATI INDUSTRIES, INC.

specially designed fixture being employed to hold the ogive firmly in place. A stamping die is used in flash removal.

In this plant the base of the ogive is smoothed off by a special fixture which holds the bottom against an electrically heated plate. This operation was for a time one of the most troublesome problems in connection with the finish of the ogives due to the fact that the removal of the flash left a rough uneven surface. Since the base material in the ogive is cotton, and since cotton will burn, the effect was to burnish the base to a glossy finish where the skirt had been trimmed away.

A certain amount of machining is necessary before the ogives are completed. The center of an ogive is bored to specification and its tip is polished by abrasion. Decalcomania markers indicate the setting mechanism of the shell.

Resin-treated creped cloth preforms

Resin-treated creped cloth has also been used in the molding of both the MK 29 and the MK 30 because of its ability to stretch in all directions. This material fills out all sections of the molds, even the thin sections near the ends. After considerable experimentation the company producing this material determined that a coil charge was the best method of loading. After the creped cloth has been split to a given width it is wound into rolls of specified diameter and weight. Each coil is inspected for dimensions, weighed and adjusted

Before molding the resin-treated creped cloth coil charge is placed in a telescoping fixture which forces it into a conical shape that conforms roughly to the cavity of the die. By this means good premolding disposition of material is attained.

High-frequency preheating

Very early in this work high-frequency preheating was considered as a means of reducing the cure time—with a consequent increase in production. When high-frequency heating was first tried on the MK 30 ogive it was found to produce a resin segregation. This difficulty was finally overcome, however, and today satisfactory ogives are being produced with the help of this type of preheating at the plants of all the molders involved in the program. In the case of both the MK 29 and the MK 30, high-frequency heating reduced cure time to about half of that required when no system of preheating is used.

Credits—Material suppliers: Cincinnati Industries, Inc., Clipper Products Co., Fabricon Products, Inc., Mine Safety Appliance. Molders: Amos Molded Plastics Div., Amos-Thompson Corp.; Armstrong Cork Co.; Indiana Molding Co.; National Tool & Mfg. Co.; Northern Industrial Co.; and Plastic Molding Corp.

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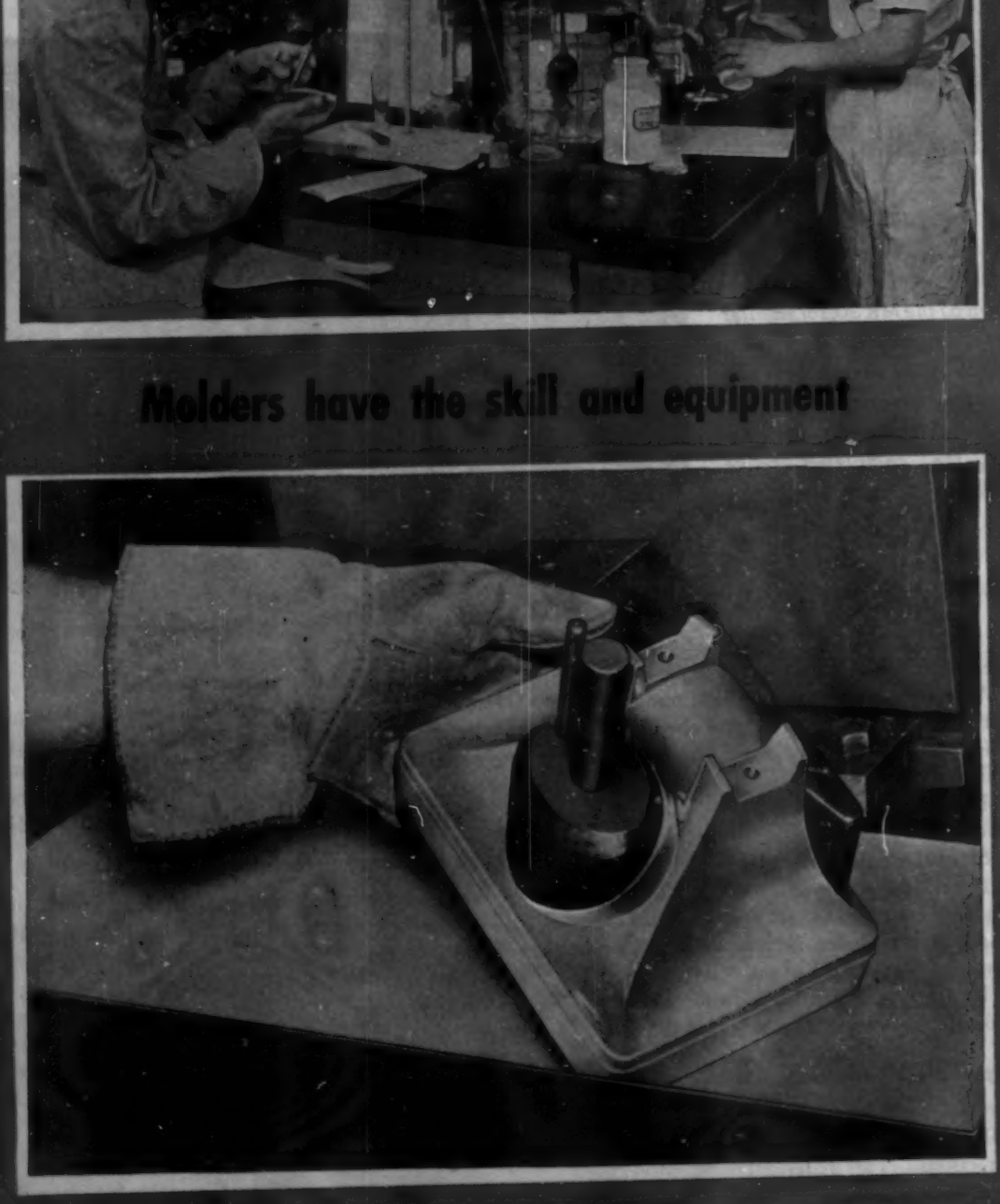

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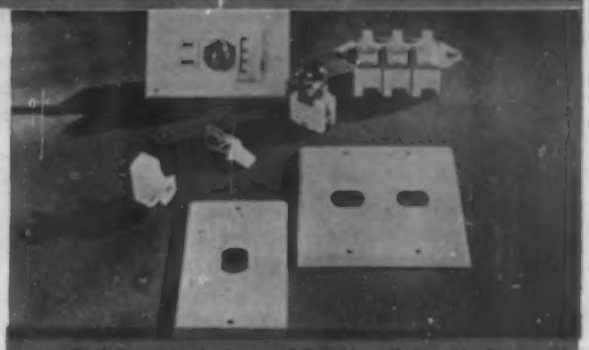
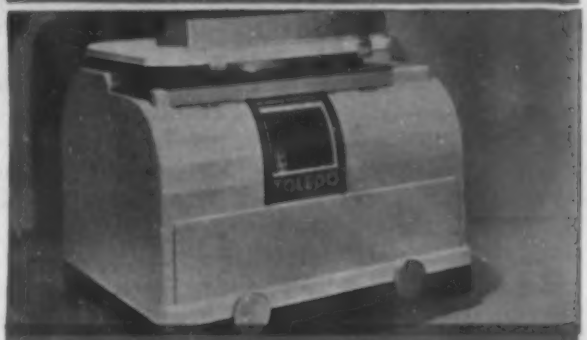
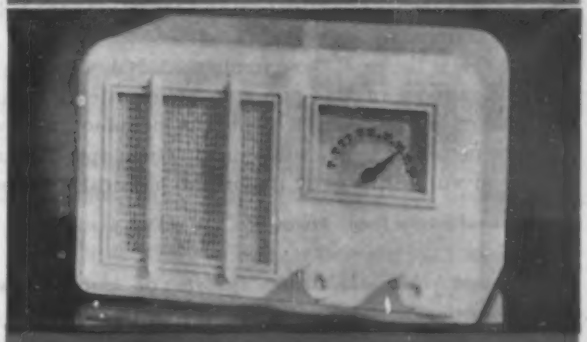


Resistance to Arcing and Tracking Makes Plaskon Urea-Formaldehyde Molded Color Widely Used for Electrical Service



Large, handsome, lightweight scale housing of Plaskon Urea-Formaldehyde Molded Color



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Processing phenolic molding materials

by FRANK J. DONOHUE*

This is the first of two articles designed to aid molders in evaluating and controlling behavior of phenolic molding materials. On the following pages, components of the resin and molding compounds are enumerated, the manufacturing process described. The second article will deal with important physical and molding properties

PHENOLIC molding materials, in various forms, have been known commercially for at least thirty years, and have been widely used in the plastics industry for about fifteen. The phenolic resins used in these molding materials are such extremely complex synthetic organic chemical substances that their chemistry is known only imperfectly even by those who have devoted years to their study.

In commercial molding compounds, these resins are combined with various fillers, pigments or dyes, and lubricants to produce still more complex substances. The composition and chemical structure of these resins and molding materials cannot be determined precisely and quantitatively by any of the usual laboratory methods. It is frequently impossible, once a molding compound has been produced, to determine by any chemical or physical test the amount of phenolic resin contained in it.

However, to the custom molders who handle these materials constantly, they have become prosaic. Their peculiarities are accepted, usually with resignation. Their physical and molding properties are studied, although not always with close attention. It is quite possible that the full importance of these properties is not always recognized. They are however the only means of evaluating and controlling the behavior of these materials.

Since this is the case, these fundamentals deserve emphasis. It is the purpose of this paper to enumerate the principal components and to describe briefly the manufacturing process for these materials. In a subsequent article, special attention will be given to the most important physical and molding properties of commercial phenolic molding compounds, their method of measurement and bearing on molding behavior.

* Technical Service Dept., Monsanto Chemical Co.

1—Through this elaborate system of ducts, raw materials in measured quantities are piped to the mixer

ALL PHOTOS COURTESY MONSANTO CHEMICAL CO.

Resins

Theoretically, a phenolic resin can be produced by the reaction under suitable conditions of many different phenols with any one of a large number of aldehydes. Actually, many of these resin reactions are difficult to bring about or hard to control. In a number of cases the resins produced are slow-curing or thermoplastic, hence unsuited for molding materials.

Phenolic molding materials, to be commercially useful, must have certain specific properties—fast cure, rigid set, smooth glossy surface in molded form, good electrical properties and good resistance to heat, moisture and chemicals. For this reason, resins produced by the reaction of either phenol, a mixture of meta- and para-cresol, or xylenols, with formaldehyde, are used commonly in the molding materials.

The cresols and xylenols, as well as phenol, can be obtained by the fractional distillation of coal tar. At one time this was the only commercial source of these materials. Cresols and xylenols are still produced by this method, but since 1918 phenol has been synthesized in rapidly increasing quantities from benzene. Synthetic phenol, because of its purity and uniformity, produces the most desirable properties in the resins and molding materials, and simplifies control problems.

The formaldehyde used in resin manufacture is produced by the catalytic oxidation of methanol. Methanol, in turn, is synthesized from carbon dioxide and hydrogen.

These resins, when classified according to the nature of the reaction occurring during their production, are of two fundamental types:

One-stage resins—In these, all the necessary reactants (phenol, formaldehyde, catalyst) required to produce a thermosetting resin are charged into the resin kettle in the proper proportions and reacted together. An alkaline catalyst is used. The resin, as discharged from the kettle, is thermosetting or heat-reactive, and requires only further heating to complete the reaction to an infusible, insoluble state.

Two-stage resins—Only part of the necessary formaldehyde is added in the kettle in making these resins, and an acid catalyst is used. They are permanently fusible or thermoplastic when discharged from the kettle, but will react with additional formaldehyde to produce a thermosetting resin.

This additional formaldehyde is furnished by "hexa" (hexamethylene tetramine), a white crystalline solid which is added during subsequent compounding and which breaks down under the influence of heat into formaldehyde and ammonia. The formaldehyde combines with the resin and converts it to a thermosetting product; the ammonia serves as a catalyst for this second stage of the reaction. These resins are, therefore, often referred to as dual catalyst resins.

Both one- and two-stage resins are used, separately or in combination, in commercial molding materials. Both types are believed to polymerize to similar end-products. Whether this is truly the case cannot be determined by chemical an-

alysis, but no significant differences in physical properties have been found between the two types. Certain differences in molding properties—flow rate and cure time—are observed; but these interest mainly the material manufacturer.

Fillers

A variety of organic and inorganic fillers are used in phenolic molding compounds. The organic fillers are various forms of cellulose, derived directly from wood or vegetable fibers or obtained as by-products from the textile industry. The inorganic fillers are natural mineral substances.

These fillers all have two common functions—they lower the cost and reduce the shrinkage of the material (as compared with the unfilled resin). In addition, they impart certain specific properties and also, unfortunately, show certain disadvantages in the molding material or molded piece.

The principal fillers are listed and briefly described below:

1. ORGANIC FILLERS

a. *Woodflour*—This is the cheapest and most universally used filler. Soft woods such as white pine are favored because of light color, low content of natural resin and good resin absorption characteristics.

The "flour" must be approximately 100-mesh to avoid specking in the molded parts. Moisture content should preferably be under 8 percent. This has an important bearing on molding properties, as will be explained later.

Woodflour produces good molding properties and fair physical properties. It absorbs moisture, however, and consequently parts molded from these materials tend to have nonuniform electrical properties.

b. *Cotton flock*—This and the chopped canvas and twisted cord referred to later on in this article are textile by-products. Flock used in black and brown materials is medium dark in color. Bleached flock is used for light colored materials.

This filler improves impact strength—the resistance to shock is three to eight times that of woodflour material, depending on the amount and fiber-length of the flock used. Molding shrinkage is less than when woodflour is used. But bulk factor is higher and pourability poorer. Hence, preforming is more difficult than with woodflour-filled material. Water absorption and electrical properties are about equal to woodflour material.

c. *Chopped fabric*—This filler raises impact strength to a value twelve times that of woodflour material. Fabric-filled material has, however, a bulk factor four times greater and cannot be preformed in automatic machines. Higher pressures must be used. Water absorption is higher, electrical properties poorer than in woodflour material.

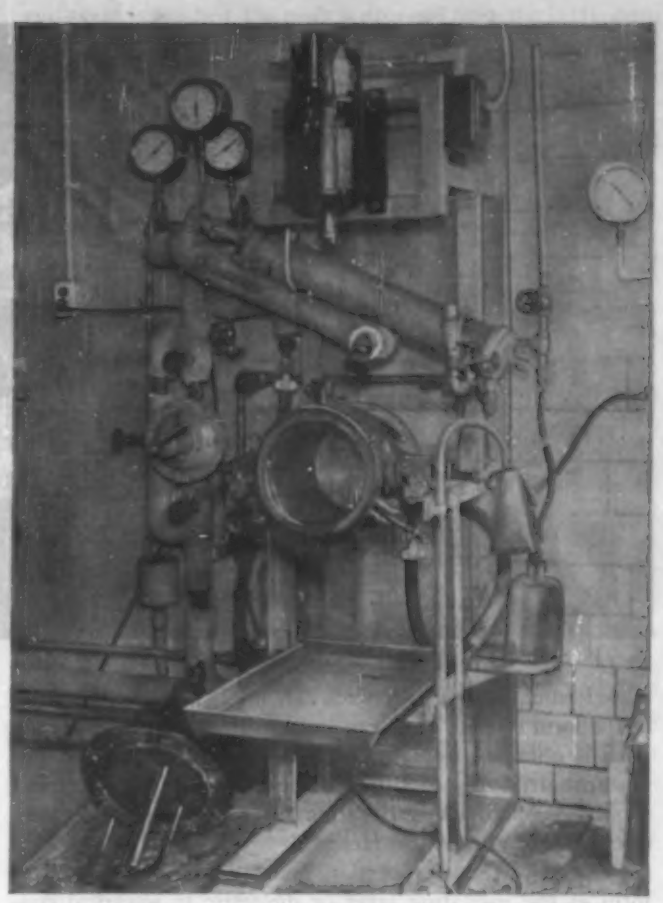
d. *Twisted cord*—This yields the highest impact strength so far obtained in molding compounds, without sacrificing flow. The impact strength is three times as great as that of fabric-filled material.

Cord-filled material has a lower bulk factor than fabric-filled material but otherwise it has the same limitations in water absorption, electrical, preforming, molding properties.

e. *Walnut shell flour*—Walnut shell flour produces a very smooth surface with medium gloss in the molded piece. Water absorption is lower than for cotton cellulose fillers but molding shrinkage is greater than for woodflour-filled material. Mechanical strength and other physical properties are comparable to those of woodflour-filled material. Cost is higher and supply more limited than woodflour.

2. INORGANIC FILLERS

Inorganic fillers as a class improve the dimensional stability of a phenolic molding compound, due principally to their low moisture absorption. They also increase heat resistance and chemical resistance as compared to woodflour and other cellulose fillers. The principal inorganic fillers are:



2—A typical laboratory resin kettle such as is used in test and development work on one- and two-stage resins

a. *Asbestos*—Asbestos is derived from the mineral chrysotile. Its chemical name is magnesium silicate, and its approximate formula is $3MgO{\cdot}2SiO_2{\cdot}2H_2O$. It occurs in nature in the unique form of silky fibers which are hard and heat-resistant but quite brittle. It is used in the form of a finely ground powder in heat-resistant, chemical-resistant and water-resistant formulations.

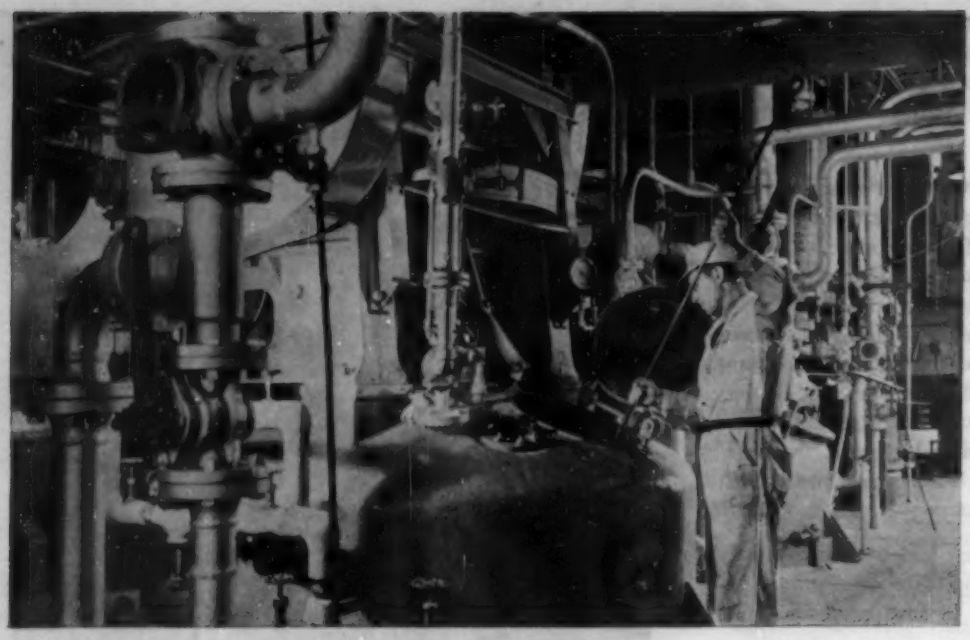
It increases the heat resistance of the material and decreases water absorption and molding shrinkage. It also lowers the flexural and tensile strength and raises the specific gravity; both of these latter effects are objectionable. Nevertheless, because of its low cost, it is a commonly used mineral filler.

Asbestos can also be used to improve the electrical properties by decreasing the water absorption if a special grade free of iron and other electrical-conducting impurities is chosen or if these impurities are removed by digestion with acid.

b. *Diatomaceous silica*—A form of silica which occurs in nature in the skeletons of microscopic marine animals called diatoms. These are found in deposits laid down during past geologic ages on sea bottoms which later became land masses.

This filler improves the molded appearance, heat-resistance and electrical properties of a material without increasing the specific gravity as much as would an equivalent amount of asbestos. Its principal drawback is its abrasive character and tendency to wear molds and cause sticking. For this reason it is usually mixed with other less abrasive fillers.

c. *Mica*—This is obtained from the mineral muscovite, a complex potassium-aluminum silicate, having the approxi-



3—At set intervals during the production of phenolic resins, samples are taken from the kettle for control tests. These large jacketed cast-iron kettles or stills are provided with slow-speed agitators and automatic temperature recorders

mate formula $K_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2H_2O$. It is found in nature in the form of thin, flat, translucent sheets. The best grade mica is obtained from India. The principal and most important attributes of this filler are its excellent electrical properties—high dielectric strength, low power factor, dielectric constant and loss factor.

Because of these properties, mica is used alone in sheet form as the insulating layer or dielectric in electrical condensers and for insulation in electrical motor commutators. When used as filler in a molding composition, it confers these same properties. Its low water absorption tends to maintain these good electrical properties in the molded parts in use.

Mica, on the other hand, has its quota of undesirable characteristics. It is not wetted readily by the resin as are the cellulose fillers, and materials in which it is used may show poor coverage after molding. This leads to a mottled appearance and may induce sticking or poor release in the mold.

Shrinkage of the molding material is reduced, as compared with a woodflour-filled composition, but mechanical strength is also lowered and specific gravity is increased.

Pigments and dyestuffs

In practically all molding compounds, except the mica-filled electrical materials, pigments or dyes are used to produce a smooth, clean, uniform color. Even many so-called natural materials contain a small amount of coloring matter. A true natural phenolic material, i.e., resin and woodflour, or other filler, would have a very mottled, unattractive color.

The amount of colored pigment or dye used will vary between 2 and 4 percent, depending on the tinting strength of the pigment, the color of the resin and the color desired in the material. In addition, white pigment is used in colored molding materials, as explained below.

Black materials—Either carbon black or nigrosine, a very concentrated alcohol-soluble organic dye, is used. The former is used in closure materials and for any application where the material must not bleed in contact with alcohol or other spirit solvents. Since carbon black is a semi-conductor of electricity, these materials have poor electrical properties and are not recommended for such applications.

Nigrosine is used in general-purpose materials and electrical materials where non-bleeding properties are not an essential requirement of the application.

Brown materials—Either organic dyes or inorganic mineral pigments can be used. The latter are preferred because they can be more readily dispersed in the material without excessively long mixing which increases production costs.

Colored materials—Phenolic materials can be produced in a wide variety of bright medium colors, but are not made or recommended for use in ivory or pastel shades. The resins used in these materials are inherently dark in color, and undergo a chemical reaction and darken further on exposure to light, particularly direct sunlight. This makes any attempt to produce stable pastel shades impracticable.

Because of the dark color of the resin, it is necessary, in order to produce clean, bright shades, to add a certain amount of opaque white pigment along with the colored pigments or dyes during compounding. Hence, nearly all phenolic colored materials are opaque. Exceptions are the transparent molding resins, which contain no filler.

Normally, in peace time, a large quantity of phenolic colored molding compounds is used in the production of closures and buttons. For these applications, the colors must be substantially or completely non-bleeding in contact with water, alcohol, acetone, ethyl acetate, and also mineral and vegetable oils, waxes and oil-water emulsions.

In these cases organic pigment dyestuffs are used. These are organic dyes which are naturally insoluble in these liquids, or which have been precipitated or fixed on white pigment bases and thus rendered insoluble.

For certain blue and green colors, dyes of the proper shade which are completely insoluble, compatible with phenolic resins and stable at molding temperatures, are not available. The best available ones are used and one must then depend on complete cure of the molded parts in order to prevent or minimize bleeding.

Usually, organic dyestuffs are preferred to colored inorganic pigments because of their much higher tinting strength. In most cases this offsets the higher cost of the dye. However, certain inorganic pigments such as prussian blue, chrome yellow and various red and brown iron oxides are used.

In spite of what was said above concerning the dark color and lack of light fastness of phenolic resins, it should not be assumed that the color possibilities of these materials are drastically limited. They are not as extensive as in the case of the thermoplastics, melamines and ureas, but normally a

large volume of phenolic materials in medium bright shades of red, green, blue, orange and light brown is used for closures, buttons and novelties. Of these, the reds, oranges, yellow-greens and browns are the most stable, since these colors approximate the colors of the base resin.

Lubricants

Because of the high pressures used in commercial molding practice, the molded part is forced into the most intimate contact with the mold surface. Every minute detail and tool mark in the mold is reproduced on the molded piece. Since the contraction in volume of the piece in the mold resulting from polymerization is extremely slight (practically all of the shrinkage occurs on cooling after ejection), means must be provided for aiding release of the piece from the mold.

To accomplish this the mold and part are designed wherever possible with a slight taper, and lubricants are incorporated in the molding material. These lubricants are usually vegetable and mineral waxes, fatty acids and metallic soaps. Examples are:

Mineral waxes	ceresin, paraffin
Vegetable waxes	carnauba, montan, candelilla wax
Fatty acids	stearic acid, oleic acid
Metallic soaps	zinc stearate, calcium stearate

Carnauba and montan wax are the most efficient lubricants but are somewhat difficult to incorporate properly in the material and are extremely scarce under present wartime conditions. Therefore, zinc and calcium stearate are favored.

None of these lubricants is truly compatible with the cured resins and will bloom or sweat out if used in amounts greater than approximately 3 percent by weight of the base resin. The presence of excess lubricant tends also to lower the mechanical strength of the molded part.

Manufacturing process

The procedures used for both one- and two-stage resins are quite similar and the same equipment is used for both types. The principal differences between the two are in the phenol-formaldehyde ratio and the type of catalyst used. For one-stage resins the ratio is approximately 1:1 and an alkaline catalyst is used. Acid catalysts are employed for two-stage resins and the phenol-formaldehyde ratio is about 1.5:1.

The resins are produced in large jacketed cast iron kettles or stills, provided with vertical, slow-speed agitators and automatic temperature recorders and equipped for both heating and cooling.

The phenol is first charged into the reaction kettle, the catalyst is added and the formaldehyde then run in slowly while heat is applied to start the reaction. Once started, the reaction is exothermic and the reaction mass must be cooled in the later stages.

The resin formed as the reaction progresses is only sparingly soluble in the water present, and a stage is reached where the mass would, if not agitated, separate into two layers—a lower resin layer containing some water, and an upper water layer containing a small amount of resin and also unreacted phenol and formaldehyde, together with intermediate reaction products. These are removed by vacuum distillation. This cools the mixture and keeps the reaction under control.

The total kettle cycle requires 6 to 8 hr. and the major part of this time is consumed in the dehydration of the resin.

Careful tests of reactivity, softening point, viscosity and solubility are made at intervals on resin samples taken from the kettle while the distillation proceeds, and when the proper end-point is reached, the resin is dropped from the kettle onto metal cooling floors.

With both one- and two-stage resins the phenol and formaldehyde first combine in what is called a condensation reaction to form crystalline addition compounds or intermediates. A considerable amount of water is formed as a by-product.

Next, these intermediates in turn react with additional phenol and formaldehyde and with one another to produce increasingly complex resinous substances which, according to theory, are at this stage made up of large molecules attached to one another in long straight chains.

With two-stage resins, where excess phenol is present, it is believed that condensation is largely confined to the formation of straight chains in the kettle reaction and the resin remains fusible although its melting point may be high.

In the case of one-stage resins, the condensation continues and the complex, straight-chain polymers unite into still larger molecular groups and cross-linking or union with groups in adjacent chains occurs. This theory is used to explain the fact that, as heating continues, the resin becomes progressively more insoluble and higher in melting point and would, if heated long enough, become completely infusible.

When dumped from the kettles, the resins are very viscous masses, having the consistency and appearance of thick molasses, when hot. On cooling, they change to hard, brittle, glassy solids, resembling natural rosin in appearance. Color varies from pale straw to dark reddish-brown, depending on the nature of the raw materials, the reaction conditions and the catalyst used.

Resin compounds—After cooling, the hard, brittle resin is broken up into coarse lumps, mixed with accelerators, lubricants, and hexa in the case of two-stage resins, and the mixture ground to a fine powder.

These resin compounds are stable and can be stored for considerable periods without deterioration. They are semi-finished products or intermediates; the addition of black, brown or colored pigments and fillers, followed by mixing on heated rolls is required to convert them to finished molding powders ready for use. The steps involved in this conversion and the properties of the resultant molding material will be discussed in a second article by Mr. Donohue scheduled for the September issue of MODERN PLASTICS.

4—The cooking complete, the viscous resin mass is dumped from the kettle onto the floor below. Here it cools, changing to a hard, brittle solid. This picture was taken during an inspection trip through the plant

Urac adhesive

Specially posed by Sidney Catlett, one of America's foremost drummers.

Drums, guitars, banjo-ukes, and other wooden musical instruments are manufactured by the Fred. Gretsch Mfg. Co. with URAC 183 resin adhesive.

WOODEN ASSEMBLIES comprising truck bodies, station wagons, and heavy timber laminations may be bonded with URAC 183 for strength, safety, economy and speed of production.

TENNIS RACQUETS, FISHING RODS, and other sporting goods which require glue lines that are resistant to moisture, mold, and crazing, are more durable when bonded with URAC 183.

helps to beat the band!

Modern swing or three-four time, the drums take a beating! And while gluing wood for musical instruments is an age-old craft, today there's new strength in wood products when they're bonded with URAC* Adhesives.

For when URAC 183 forms the glue line, the wood will break before the glue! This resin adhesive retains its strength in glue-line thicknesses up to .020 of an inch—*twice* that of former cold-setting assembly cements! And that's only part of the story.

Curved, complex shapes can be more easily joined. The low-pressure setting of URAC 183 speeds assembly. Crazing of the glue line, damage from water or mold, are practically non-existent.

URAC 183 is the *new glue* that holds the answer to many heretofore difficult or even impossible bonding problems. Some of the fields in which it has already demonstrated its advantages are shown below. When you require an adhesive embodying these qualities, specify URAC 183—one of Cyanamid's outstanding contributions to adhesive progress. Complete information will be supplied on request. **Reg. U. S. Pat. Off.*

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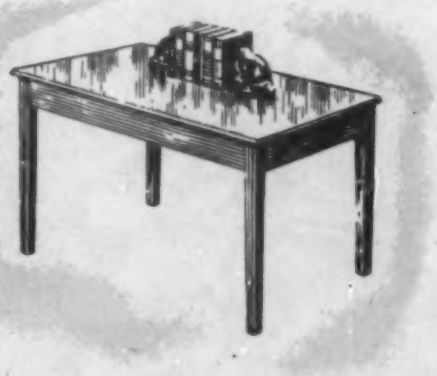
Cyanamid Plastics — *Beetle · Melmac · Melurac · Laminac · Urac*



FOR FURNITURE MAKING, where it may be difficult to apply sufficient pressure for a uniformly thin glue line, URAC 183 will form a craze-resistant, durable bond in thicknesses up to .020".

FOR DOORS AND CABINET WORK this low-pressure, craze-resistant adhesive is particularly applicable for speed of production, strength, and permanence of bond in the finished product.

AIR DUCTS ON THE B-29

PRESS ASSOCIATION, INC.

To the long line of plastics processes and plastics parts which, created to meet some critical wartime need, give promise of even more interesting peacetime applications, add defroster ducts for B-29's made of glass cloth impregnated with one of the newest of the alkyl family of contact resins.

THE need for defroster ducts in B-29's is due primarily to the fact that in the zones in which these planes operate, minus zero temperatures are the rule rather than the exception. Though the ship is pressurized against the conditions which exist in the upper reaches of the sky, once this pressurization is lost, as it is when the fuselage is pierced by enemy gunfire or flak, frosting of cabin and turret windows would be a major operational hazard were it not for the presence of these defrosting ducts in the plane which immediately counteract any adverse effects from such a source.

At first these parts were made of aluminum, tailored to a tortuous pattern demanded by the design of the airplane fuselage. Meanwhile a search was being made for a new material or a new method of forming an old material which would have the necessary properties of lightness, dimensional stability, close tolerances, easy manipulation and workability, and would at the same time produce air ducts that would be free from odor and possess high impact strength and resistance to heat, vapors and moisture. Plastics in some form seemed to be the answer, but in attempting to determine the kind of plastic, its method of manufacture and the speed with which parts could be turned out, suppliers encountered setback after setback.

Such was the case with a Detroit firm invited by Boeing Aircraft Co. to bid on ducts and duct sections. Already familiar with and experienced in techniques of low-pressure bag and contact-pressure molding, this company made tentative experiments to try to fit these methods to the task of producing the ducts. When it was determined that these methods would not work satisfactorily, company engineers turned their attention to low-pressure laminates and various types of contact resins, retaining some features of the low-pressure and contact pressure molding operations and abandoning others as experiments progressed.

The dissimilarity of the duct sections and their varying dimensions made the use of molds prohibitive since no one part was planned in such production quantities as to make the

FIGS. 1 THROUGH 5, COURTESY PARAMOUNT RUBBER CO.

1—Glass cloth impregnated with alkyl resin replaced aluminum in the airducts for the B-29. The change in material was dictated by the tortuous patterns of these parts which were difficult to reproduce in metal

outlay for molds a possibility or a good investment. The longest section is some 45 in. in length and has 17 compound curves. The lip or circular diameters of the ducts vary from 1/2 to 9 inches. The sections individually and assembled are held to within a tolerance of 30 thousandths of an inch. Besides this, an exact juncture with the other plane fittings is required of the part.

Low melting point metal cores

The current production method of this Detroit firm embodies the use of quickly made wood patterns and plaster molds to form an aluminum mold in which is cast a metal core or wrapping base for the duct. From the wrapping base to the final surface finish the process is one of plastics applied in a new way.

In the construction of the wood pattern allowance is made for shrinkage of the aluminum cores. The thickness of the material to be used for the duct is also taken into consideration, the dimensions of the pattern being reduced by that amount. From the wood pattern is made a plaster of Paris mold to which a phenolic resin has been added to give increased tensile strength and smoothness. The plaster mold is used to make the aluminum casting mold (a female mold), which is kept as thin-walled and as light as possible—outer metal stock being removed as completely as is compatible with safety. The mold is conventional in design, separating horizontally in halves to permit the removal of the casting without any difficulty.

The aluminum mold is put together and cerrebase metal, heated to 300° F., is poured into it. Before pouring, the mold has been brought to 150° F., thereby insuring a smooth outer surface on the male casting, which becomes the wrapping form. The same technique that is used in pottery making is employed in casting the wrapping form, that is, the heated cerrebase is poured quickly in and out of the mold. As a result the cast is a hollow shell with walls approximately 1/4 in. thick. Where the part is unusually large or the diameter is such as to put added strain on the wrapping form, the melted cerrebase is allowed to remain for a longer period of time in the mold; and the longer it remains, the thicker will be the walls.

The casting metal has a melting temperature of 250° F., a fact of considerable importance later on in the operation. It cools quickly without loss of outside dimension and holds its correct dimension until its critical temperature of 250° F. is finally reached.

When the wrapping forms have been removed from the mold they are placed on fixtures, one on each side of a steel table. This arrangement permits operators to work without interference in the process of hand or machine wrapping the forms with layers of impregnated glass cloth which is cut to 1 1/2- and 1-in. widths.

In impregnating this cloth, a spool of tape is placed at one end of a series of rolls which carry the material through the resin bath. The resin is thick, light-brown and sluggish and has, among other properties, pronounced "tack." It is placed on the tape in a smooth coating as the tape is fed past doctor knives which meter an exact quantity of resin and thereby insure uniform surface coverage. Capillary attraction resulting from this procedure insures the complete impregnation of tape with resin as it is fed onto a spool. Then,

2—Cerrebase metal forms around which the glass cloth is finally wrapped, are cast in the aluminum molds (shown above). The time the low melting point metal is allowed to remain in the aluminum mold depends on the wall thickness that may be desired

3—Production methods at one plant involve the use of quickly made wood patterns, plaster and aluminum molds, and low melting point metal forms

the tape is pulled through the resin bath by hand. Experience proved, according to company engineers, that thorough and uniform impregnation was of outstanding importance in insuring acceptable production.

The impregnated tape is wrapped tightly about the metal form and overlapped in such a manner that two complete wrappings are the equivalent of four layers of glass cloth. For the first layer, impregnated tape 1 1/2 in. wide is used, while 1-in. tape is used for the top or surface layer. Where there are abrupt turns or bends, narrower tape is used on the first layer. There is also a difference in the thickness of glass cloth used for the wrappings. In the first layer 128 cloth—7 mills thick, weighing 6 oz. per sq. yd.—is used. The second layer is made of 116 cloth—4 mills thick, weighing 4 oz. per sq. yd. To remove the protective oil film on the glass fiber strands and to facilitate impregnation, the glass cloth is heat treated at this plant, being subjected to a temperature of 400° F. for 4 hours.

When all the forms that are mounted on a single steel table have been wrapped, the table and its forms are moved into an oven for a 3-hr. cure at 175° F. After curing, the wrapped forms are removed from the steel supporting table and while still hot are placed in an oil bath, where a temperature of 300° F. is maintained. Since the metal form on which the ducts and parts have been wrapped melts at 250° F. and since they have been kept in the ovens for 3 hr. at 175°, the process of melting the metal from the inside of the wrapping forms is a matter of minutes.

The bottom of the electrically heated tank holding the hot oil is inclined so that the metal, as it melts and drains from inside the wrapped forms, collects near a drawoff spout and is later removed. The glass-cloth forms, freed of the weight of the metal, rise to the surface of the oil, are pulled out and placed in a degreasing bath. The degreasing bath consists of two tanks of carbon tetrachloride—one having a sump pump to keep the fluid agitated. Here as in the oil bath the amount of liquid displaced by ducts reduces their weight to a point where they cannot possibly cause damage to each other by chance contact.

From the degreasing bath the parts go to the finishing jigs to receive whatever machining, drilling, cutting or joining may be required.

Some of the ducts must be welded together, so involved is the finished contour. If such is the case, the two parts—their ends trimmed to equal dimensions—are locked in a jig and the joint area is wrapped with tape. After wrapping, a battery of infrared lights is turned on at this juncture, bringing the temperature to approximately 300° F. This insures

4—Impregnated glass cloth strips are wound around the metal forms in such a way that two complete wrappings are the equivalent of four layers of the glass cloth

5—Still mounted on the wrapping tables, the defroster ducts are moved into the curing room where they are kept at a temperature of 175° F. for 3 hours. At the end of this period the wrapped forms are placed in a hot oil bath which is maintained at a temperature of 300° F.

6—Since the metal forms on which the ducts are wrapped melt at 250° F., and since the parts have been kept in the ovens for 3 hr. at 175° F., the melting of the metal from the inside of the wrapping forms, once they have been placed in the bath, takes but a few minutes

7—For the final machining and fitting of the ducts, the parts are placed in special jigs and fixtures. When two sections must be joined, the joint is wrapped with impregnated glass cloth and cured for about 15 minutes

8—The intricacies of the contours of the defroster ducts are most evident in the shipping room where the parts are given a final inspection. Here they are sorted and carefully packed for shipment to plane factories

a satisfactory weld in 15 min.—a weld which must conform to all individual part tests and specifications as to strength, stability and like qualities.

After final inspection, the parts are sprayed with regulation Air Corps green paint. Where specified, instructions are applied to the exterior surfaces of the parts through the use of decalcomania labels.

Tests prescribed by the Army Air Forces and Boeing Aircraft governing the performance and physical properties of the ducts and parts have been met, and in some instances exceeded, according to tests conducted in laboratories of this Detroit company. The standard requirement for the ducts are that they shall retain their dimensional stability for 72 hr. at 300° F. with no noticeable emission of odor. At this particular plant, ducts have been exposed to 500° F. for 6 hr. without distortion of dimensions or emission of noticeable odor. Further, tests have shown the ducts to have an impact strength of 50 ft.-lb. per sq. in. on the Izod scale and a tensile strength of 80,000 p.s.i. The parts show a water absorption of 0.53 percent after 24 hr. immersion at room temperatures and a compression strength rating of 80,000 p.s.i. in tests.

While the above tests are basic with the Air Forces and Boeing Aircraft, other tests are in progress which are expected to disclose other data having particular bearing on possible postwar applications of both the materials and the methods of manufacture as developed in connection with the manufacture of B-29 parts.

In connection with production of these air ducts, the speed with which the company got into production is of particular significance. Starting with an initial order of 4 parts, within 3 weeks the company was turning out parts which passed Air Forces requirements. Development since that time has been directed toward reducing production time on each part, an undertaking which is still in progress.

Since the initial order, production has been expanded to include the manufacture of 12 additional parts or sections so that the company is now producing a number of separate parts for various applications on the B-29's and other types of aircraft.

Several interesting production sidelights have been brought to light as the work has progressed. One is that the method of production is best adapted to radius applications, rather than to flat surfaces. Another fact is that variation in the temperature during curing has a direct and measurable effect on the time required for this phase of the process, suggesting the possibility of using a "line" production technique where production totals make it economical.

Hollow plastic core

In contrast to the previously described method of forming the B-29 air ducts on low melting point metal cores, a Buffalo concern employs hollow plaster cast cores in female plaster molds as the wrapping forms for the impregnated glass cloth. After the glass cloth has been tailored to pattern, it is laid up on these plaster forms after a suitable separating medium has been applied. The lay-up completed, the parts are wrapped with cellophane strips and baked in an oven without pressure at 280° F. for 15 minutes. Upon completion of the cure, the plaster forms are broken by blows of a rubber mallet on the outside surface of the ducts. The plaster can then be removed in pieces from the open ends of the completed parts.

Postwar application in artificial limbs

Among the possible postwar applications of this method of duct manufacture are artificial limbs. It is natural that the manufacture of artificial arms and legs should be considered since it has been proved that the methods used in the manufacture of air ducts are most effective when employed in "round" applications. In addition, since the problems of irregular contours and varying circular dimensions present in the manufacture of artificial limbs have already been solved, there is a further incentive to utilization of this process for such applications.

Although the method employed in the manufacture of defroster ducts has not yet been attempted commercially in

FIGS. 9 THROUGH 12, COURTESY ATLAS MOULDED PRODUCTS CORP.

9

10

9 and 10—At another molding company engaged in the production of the ducts, plaster of Paris cores were used instead of the low melting point metal forms. Using plaster, the cores are broken out from inside the impregnated cloth air ducts instead of being melted out as is the case when metal forms are used

connection with the manufacture of artificial limbs, the thinking of the company engineers is along these lines, particularly with reference to the manufacture of individually matched and fitted legs—one of the principal headaches which face both Army and Navy medical personnel in rehabilitating wounded veterans.

As experimentally worked out, the procedure in the manufacture of artificial plastic limbs calls for using the patient's undamaged limb as the basis of a model for a wrapping form. In this method, liquid latex would be sprayed on the undamaged leg after the skin had been coated to permit easy removal of the coating. When turned inside out, this later mold would provide an accurate form for the shaping of a plastic-reinforced cast.

This cast, in turn, would become the basic wrapping form for the laying up of the impregnated glass cloth. Core removal could be accomplished by drilling a hole in the plaster core and removing the plaster piecemeal. A solid limb section of plastic would be left requiring only conventional machining and the application of the established fittings. In this connection, the company has devised a molded socket of plastic. The same properties that make plastic ducts suitable for B-29 and other airplane installations, also would serve to recommend the artificial plastic leg for the withstanding of the most severe service to which it might be subjected by the wearer.

This plastic may also find postwar use in air conditioning equipment, automobile body sections, in furniture, luggage and household appliances. Meanwhile production of defroster ducts for the B-29 superfortresses and other like items continues to proceed at a gradually accelerating pace for the swiftly moving air warfare still in progress.

Credits—Material: Fiberglas. Resin: Plaskon. Molded by Paramount Rubber Co. and Atlas Moulded Products Corp.

11—A varied collection of hollow plaster cores on which the impregnated glass cloth tape is laid up. 12—This defroster duct for the B-29 plane is one of the many which are produced with the help of plaster cores

11

12

Irrigation tubes extruded by Detroit Macoid Corp. and Extruded Plastics, Inc.

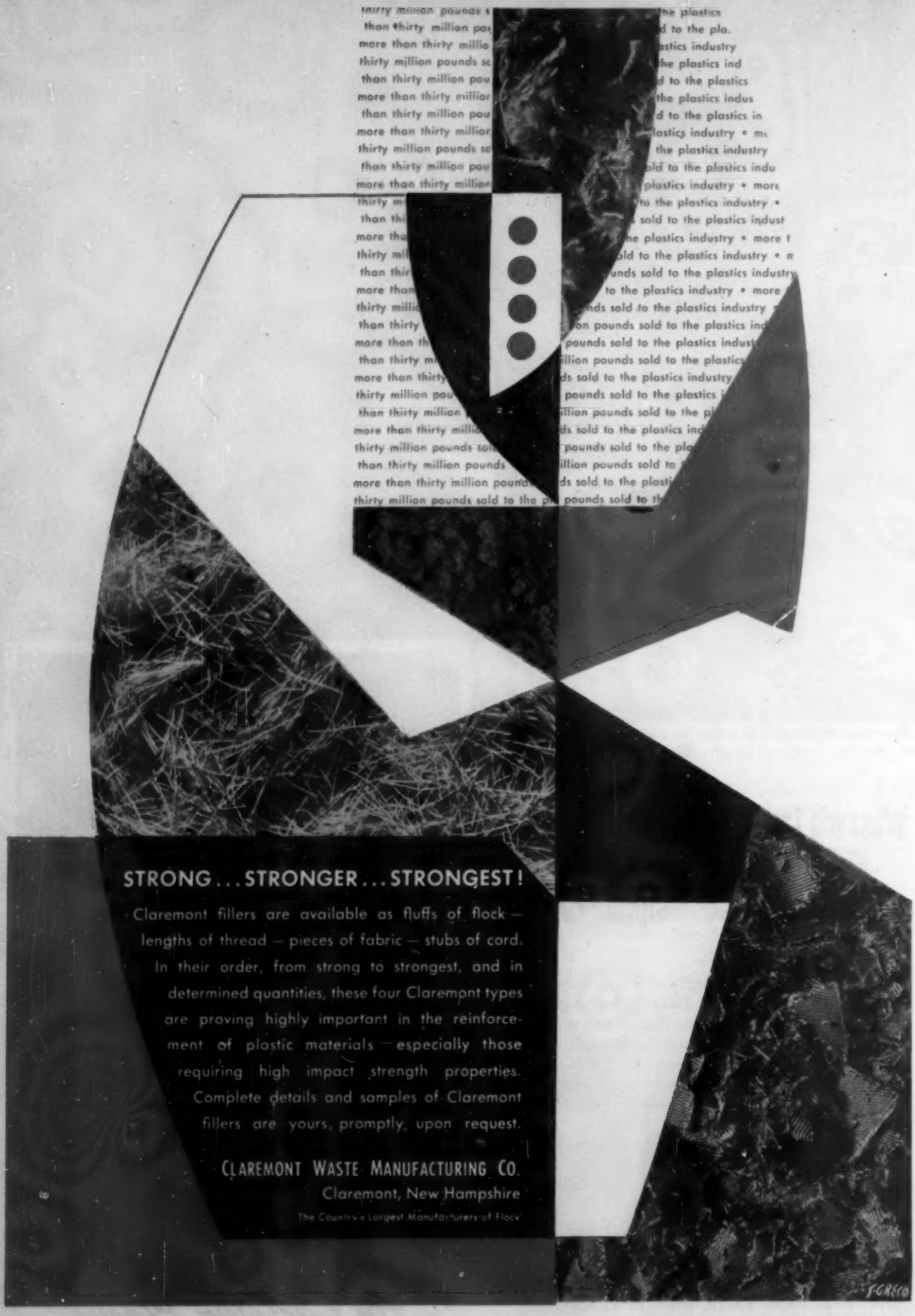
Western farmlands irrigated with *Tenite* siphon tubes

Tubing extruded of transparent Tenite is widely used for irrigation purposes. Developed through the University of Nebraska, this method of irrigation requires a minimum of labor and maintenance. Bent lengths of tubing are merely hung over ditch banks, and water is siphoned through them from the lateral into the rows. Possible obstructions may readily be seen through the transparent plastic.

Made of tough, lightweight Tenite, these irrigation tubes are easily carried and durable. A special butyrate formula of Tenite containing an ultra-violet inhibitor adds weather protection.

Uses for extruded Tenite tubing are many and varied —others include beer cooling coils, oil and air lines, carbon paper spools for business machines, manometers, and blueprint storage tubes. To obtain further information about Tenite, write to TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Company), KINGSPORT, TENNESSEE.

An Eastman Plastic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TECHNICAL SECTION

DR. GORDON M. KLINE, Technical Editor

Effect of molding pressure and resin on static and fatigue strengths of compreg*

by W. N. FINDLEY, W. J. WORLEY and C. D. KACALIEFF†

SEVERAL investigators have reported the static properties[1-9] of compressed impregnated plywood (compreg); others have studied fatigue characteristics[10,11] of this type of material. The tests reported herein were undertaken in order to provide information on the effect of different molding pressures and resins on the static strength properties, stiffness and fatigue strength of compreg.

The following tests—static tension, static compression, static torsion and rotating-beam-type fatigue tests—were performed on six different samples at 77° F. and 50 percent relative humidity. All specimens were cut with their long axis parallel to the grain of the wood used in making the compreg. Values of ultimate strength, yield strength and modulus of elasticity were obtained from all of the static tests. The fatigue tests made on the specimens were carried to 10 million cycles.

Materials

Six compreg panels were prepared especially for this series of tests by the United States Forest Products Laboratory at Madison, Wisconsin. The panels were made from rotary-cut sap yellow birch of $^1/_{16}$-in. thick plies. All veneers were from the same shipment and met the grain requirements of Army Air Forces Specification 15065. Previous to laminating, the birch veneers were cylinder-treated for 6 hr. in the case of the water-soluble resin and 16 hr. in the case of the alcohol-soluble resin at 75 p.s.i. and dried for 18 hr. at 130° F. All plies were glued on one face with Bakelite XC-7381 resin using 6.7 gm. of dry glue per square foot of glue line; all panels were pressed at the pressure indicated in Table I under conditions such that the center of each panel was held at 305 to 310° F. for 15 minutes. All panels were cooled to 150° F. in the press before releasing the pressure.

As shown in Table I, which was prepared by the Forest Products Laboratory, three different resins—*A*, *B* and *C*—were used and two panels were made with each resin. One panel for each resin was molded at 1500 p.s.i. while the other panel for each resin was molded at 600 p.s.i. The six test panels were made from sheets of treated veneer about 30 in. wide by 48 in. long in the direction of the grain. From these veneers, panels 14 by 14 by $^1/_2$ in. thick were prepared as described above. The six panels were matched in such a way that the top ply in each panel, for example, was taken from the same sheet of veneer, the next ply in each panel from another sheet, etc. Corresponding plies in panels 204: 206: 208 (Table I) were originally end to end (along the grain) in the veneer, and corresponding plies in panels 205: 207: 209 were likewise end to end. Panels 204: 205: 206: 207: and 208: 209 were thus matched so that corresponding plies were originally side by side in the veneer from which the plies were cut. The panels were matched as just described in order to insure that each panel would be as nearly as possible identical to every other panel in every respect, with the exception of the resin that was used, the amount of molding pressure and the number of plies (15 or 17).

Additional data shown in Table I include the percentage resin content, code number for the resin, number of plies

TABLE I.—FOREST PRODUCTS LABORATORY DATA ON COMPREG PANELS TESTED

	Panel 204	*Panel 205*	*Panel 206*	*Panel 207*	*Panel 208*	*Panel 209*
Type of resin[a]	A	A	B	B	C	C
Resin content,[b] percent	28.5	28.0	31.5	32.0	28.0	28.5
Number of plies	17	15	17	15	17	15
Bonding pressure, p.s.i.	1500	600	1500	600	1500	600
Specific gravity	1.36	1.22	1.36	1.24	1.37	1.24
Shear parallel to laminations,[c] p.s.i.	4840	3640	4450	4230	4340	3620
Izod impact strength,[d] ft.-lb./in. of notch	10.0	8.3	7.8	6.1	9.4	6.6
Water absorption,[e] percent	3.0	7.0	1.7	5.0	2.0	6.7
Swelling,[f] percent	14.2	13.9	9.7	9.9	11.5	12.2
Residual swelling,[g] percent	2.90	2.97	1.87	2.22	2.28	2.00

[a] Description of resins:
Resin *A*. Bakelite BV-10678; alcohol-soluble; Bakelite Corp.
Resin *B*. Bakelite BV-15100; water-soluble; Bakelite Corp.
Resin *C*. Compregnite; water-soluble; Casein Co. of America.

[b] Resin content on basis of dry weight of untreated wood.

[c] Shear tests made by Forest Products Laboratory block shear method in plane of laminations.

[d] Izod values calculated from notched toughness values, using empirical conversion factor obtained from Izod and notched toughness tests on matched specimens.

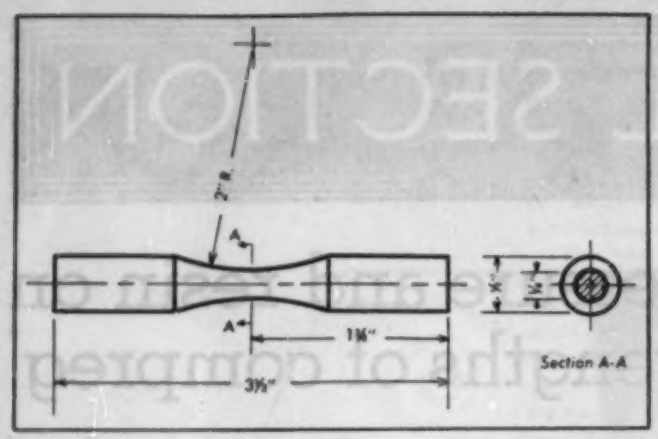
[e] Measurements made according to Army Air Forces specification 15065 on 3 by 1 by $^3/_4$ in. specimens (1 in. in fiber direction), immersed in water for 24 hours.

[f] Specimens were cut the full thickness of the panel and $^1/_2$ in. long in the direction of the grain. The specimens were immersed in water for 48 hr. at room temperature and were measured in the direction of the thickness of the original panel before and after immersion.

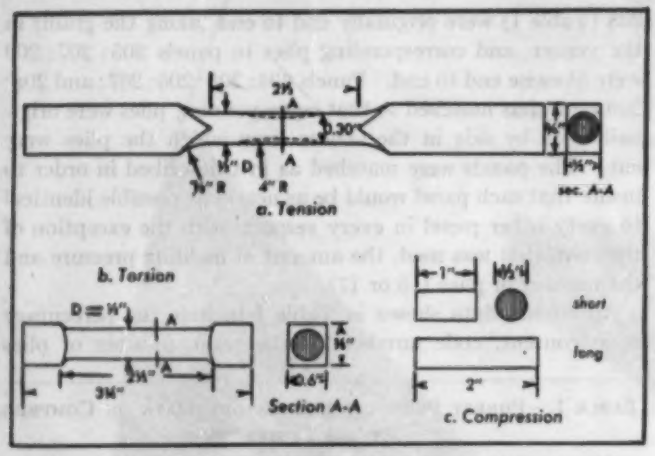
[g] Thickness of specimens used for swelling tests after subsequent air drying and oven drying, expressed as a percentage of the thickness of a matched specimen subjected to the same drying cycle but not to the water immersion. The "thickness" measured was in the direction of the thickness of the original sheet.

* Contributed by the Rubber and Plastics Division of the American Society of Mechanical Engineers.

† Assistant professor, instructor and research assistant, respectively, in Theoretical and Applied Mechanics, College of Engineering, University of Illinois.



1—*Specimens used in this investigation were cut from panels with their long axis parallel to the wood grain*



2—*Some tension specimens (a) were machined with a straight cylindrical portion. Torsion (b) and compression (c) specimens were made by turning on a lathe*

used in the panel, specific gravity, shear strength parallel to the laminations, impact strength (expressed as an equivalent Izod test), percentage water absorption, percentage swelling and percentage recovery after wetting.

Specimens

The specimens used in this investigation are shown in Figs. 1 and 2. All specimens were cut from the panels with their long axis parallel to the grain of the wood. They were machined on a lathe and then finished by means of polishing with grade 2/0 emery paper.

Some of the tension specimens were machined with a straight cylindrical portion and used for stress-strain data; others of these specimens were machined with a reduced section or neck at the center of the gage length and used to determine the ultimate strength of the compreg in tension. For this latter purpose the specimens were necked down by turning on a lathe to a 4-in. radius. This was accomplished by rotating the compound of the lathe. These specimens were reduced from $^1/_2$-in. diameter at the end of the test section to $^9/_{10}$-in. diameter at the center. This reduction was found necessary in order to cause the specimen to fail at the center of the test section rather than in the shoulder of the specimen. Straight specimens failed at the shoulder as a result of the stress concentration.

The compression specimens were turned on a lathe to the two lengths shown in Fig. 2c. The 2-in. specimen was used to obtain stress-strain relationships; the 1-in. specimen to obtain ultimate strength values only. The torsion specimens were also made by turning on a lathe.

The machining of all specimens was done in a laboratory maintained at constant temperature and constant relative humidity. After the specimens were completed, they were allowed to remain in this room, which was maintained at 77 ± 1° F. and 50 ± 2 percent relative humidity for at least two weeks before the tests were started.

Test procedures

The test methods and equipment used in the static tension, compression and torsion tests have been described and illustrated previously.[12]

Fatigue tests were performed on rotating cantilever-beam type fatigue machines shown in Fig. 3. This machine consisted of a motor-driven spindle B to which the specimen A was attached co-axially by means of a split collet. A shaft extension C was fastened to the other end of the specimen by means of a collet machined integral with the shaft. The entire assembly (spindle, specimen and extension shaft) was rotated at a speed of 6200 r.p.m. by a motor which was driven through a V-belt.

The specimen was bent downward by a load applied through a small ball bearing to the end of the extension shaft. This load was produced by a beam and poise mechanism D. The stress σ at the minimum section of the specimen was computed from the equation $\sigma = \frac{Mc}{I}$ in which M was obtained from the load applied by the poise with suitable correction for the moment produced by the extension shaft. In order

TABLE II.—TENSION TESTS ON COMPREG PANELS

	Panel 204	*Panel 205*	*Panel 206*	*Panel 207*	*Panel 208*	*Panel 209*
Type of resin	A	A	B	B	C	C
Molding pressure, p.s.i.	1500	600	1500	600	1500	600
Stress-strain tests (constant cross-section specimens)						
Number of specimens tested	2	2	2	2	2	2
Modulus of elasticity, 10^6 p.s.i.						
Range	4.10–4.13	3.70–3.74	4.20–4.20	3.90–3.94	4.12–4.34	3.86–3.90
Average	4.12	3.72	4.20	3.92	4.23	3.88
Approximate rate of strain, in./in./min.	0.0017	0.0013	0.0017	0.0015	0.0015	0.0014
Ultimate strength tests (reduced cross section at center of specimen)						
Number of specimens tested	3	3	3	2	3	2
Ultimate strength, p.s.i.						
Range	56,500–51,700	44,500–42,800	55,600–53,600	44,400–42,600	53,000–50,000	49,000–46,800
Average	53,700	43,600	54,600	43,500	51,300	47,900

TABLE III.—COMPRESSION TESTS ON COMPREG PANELS

	Panel 204	*Panel 205*	*Panel 206*	*Panel 207*	*Panel 208*	*Panel 209*
Type of resin	A	A	B	B	C	C
Molding pressure, p.s.i.	1500	600	1500	600	1500	600
Stress-strain tests (two-inch specimens)						
Number of specimens tested	2	2	3	3	3	2
Modulus of elasticity, 10^6 p.s.i.						
Range	4.00–4.42	3.64–3.94	4.16–4.18	3.92–4.20	4.30–4.38	3.90–3.98
Average	4.21	3.81	4.17	4.07	4.33	3.94
Yield strength at 0.2 percent offset, p.s.i.						
Range	20,900–20,400	18,500–19,300	21,400–22,500	20,400–21,600	21,500–21,800	19,500–20,200
Average	20,700	19,000	21,900	21,000	21,600	19,900
Yield strength at 0.05 percent offset, p.s.i.						
Range	18,900–19,500	16,400–18,100	19,800–20,300	19,000–20,200	20,000–20,100	18,200–19,000
Average	19,200	17,500	20,000	19,400	20,100	18,600
Approximate rate of strain, in./in./min.	0.0014	0.0015	0.0015	0.0014	0.0015	0.0015
Compressive strength tests (one-inch specimens)						
No. of specimens tested	3	3	4	4	4	4
Ultimate strength, p.s.i.						
Range	24,100–24,200	22,400–22,800	26,600–27,000	25,000–25,300	23,820–25,600	22,600–23,000
Average	24,200	22,700	26,800	25,200	24,500	22,800

to determine the number of cycles to cause failure a counter *E* was attached to record the number of cycles and a microswitch *F* was used to stop the machine when a crack had started in the specimen.

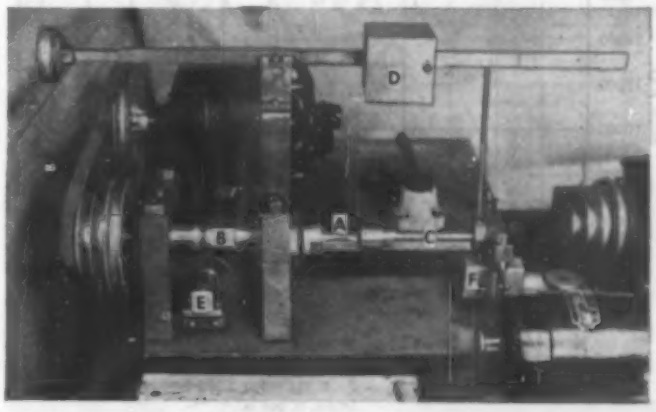
Tension tests

Results of the tension tests are shown in Table II. Diagrams of stress versus strain and strain versus time are plotted in Figs. 4 and 5, respectively. The average modulus of elasticity in tension was found to vary from 3,720,000 to 4,230,000 p.s.i., depending on the resin and molding pressure used; and the average ultimate tensile strength was found to vary from 43,500 to 54,600 p.s.i., depending on the resin and molding pressure. The data in Table II show that both the ultimate strength and modulus of elasticity are higher for compreg molded under 1500 p.s.i. pressure than for compreg molded at 600 p.s.i. This is true for each of the three resins investigated. The increase in ultimate strength resulting from increasing the molding pressure from 600 to 1500 p.s.i. was 23.2 percent when resin *A* was used, 25.5 percent when resin *B* was used and 7.1 percent when resin *C* was used. The corresponding increase in tensile modulus of elasticity was 10.7 percent with resin *A*, 7.2 percent with resin *B*, and 9.0 percent with resin *C*.

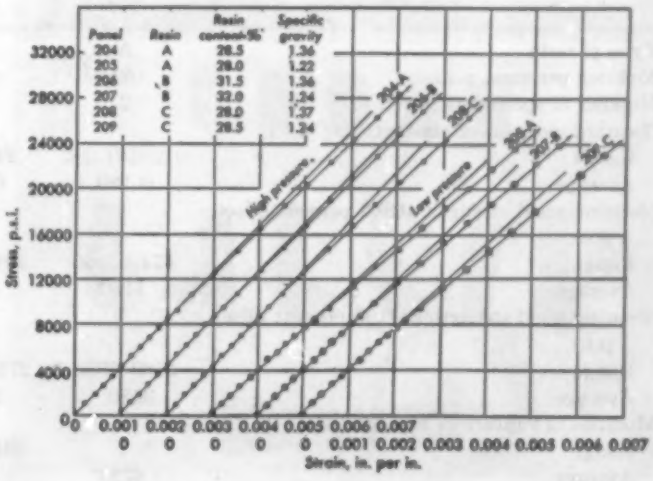
Compression tests

Results of the compression tests are shown in Table III. Diagrams of stress versus strain and strain versus time are plotted in Figs. 6 and 7, respectively. The average modulus of elasticity in compression was found to vary from 3,810,000 to 4,330,000 p.s.i., depending on the resin and molding pressure used. The average ultimate strength in compression was found to vary from 22,700 to 26,800 p.s.i., depending on the resin and molding pressure. The data in Table III show that the modulus of elasticity, ultimate strength and yield strengths in compression are about 5 percent higher for compreg molded under 1500 p.s.i. pressure than for compreg molded at 600 p.s.i. This is approximately true for each of the resins investigated.

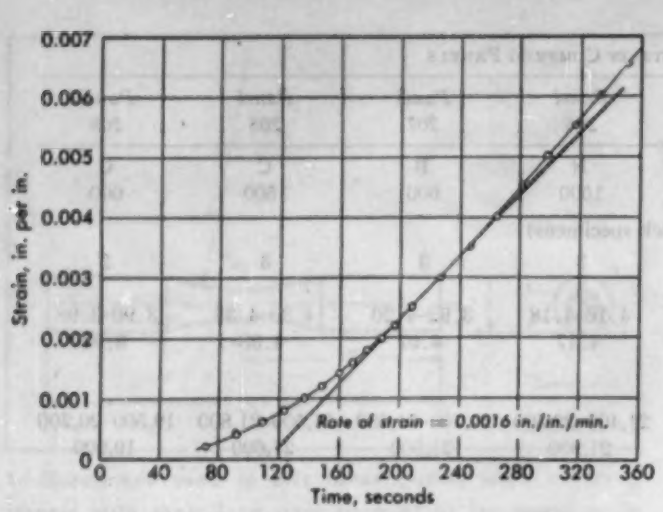
The increase in modulus of elasticity in compression result-



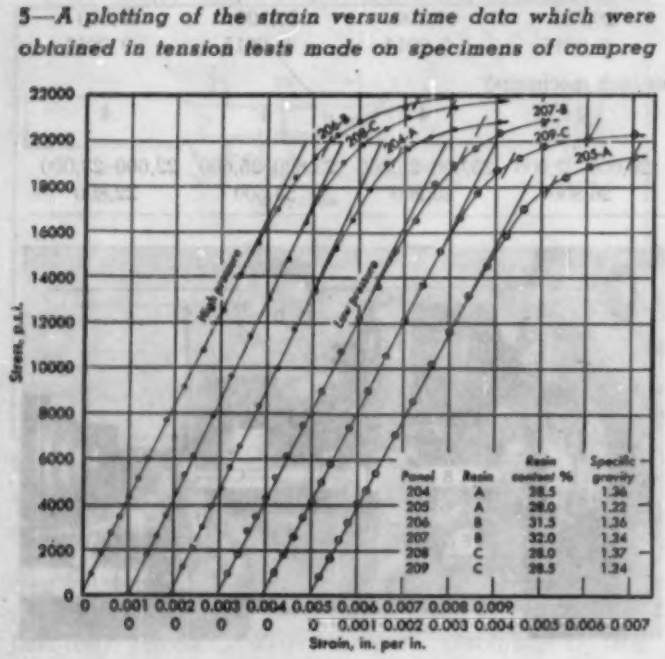
3—Rotating cantilever-beam type fatigue machine consisting of: a motor-driven spindle (B), to which specimen (A) is attached, a shaft extension (C), a beam and poise mechanism (D), a counter (E) and a microswitch (F)



4—The stress versus strain data obtained from tension tests made on the specimens is shown in this diagram



5—A plotting of the strain versus time data which were obtained in tension tests made on specimens of compreg


Stress, p.s.i.
Strain, in. per in.
High pressure
Low pressure
Panel | Resin | Resin content % | Specific gravity
204 | A | 28.5 | 1.36
205 | A | 28.0 | 1.22
206 | B | 31.5 | 1.36
207 | B | 32.0 | 1.34
208 | C | 28.0 | 1.37
209 | C | 28.5 | 1.34

6—Results of compression tests which were made to determine stress versus strain effects on the specimens

7—Strain versus time data on compression tests perforated on the specimens and expressed diagrammatically

ing from increasing the molding pressure from 600 to 1500 p.s.i. was 10.5 percent when resin *A* was used, 2.5 percent when resin *B* was used and 9.9 percent with resin *C*. The corresponding increase in ultimate strength was 6.6 percent with resin *A*, 6.3 percent with resin *B* and 7.5 percent with resin *C*. The increase in yield strength at 0.2 percent offset was 8.9 percent with resin *A*, 4.3 percent with resin *B* and 8.5 percent with resin *C*. Corresponding values for the yield strength of the specimens at 0.05 percent offset are 9.7, 3.1 and 8.1 percent, respectively.

Torsion tests

The results of the torsion tests are tabulated in Table IV. Curves of time versus shearing strain and shearing stress versus shearing strain are plotted in Figs. 8 and 9, respec-

TABLE IV.—TORSION TESTS ON COMPREG PANELS

	Panel 204	*Panel 205*	*Panel 206*	*Panel 207*	*Panel 208*	*Panel 209*
Type of resin	A	A	B	B	C	C
Molding pressure, p.s.i.	1500	600	1500	600	1500	600
Number of specimens tested	2	3	3	3	2	2
Shearing modulus of elasticity, 10^6 p.s.i.						
Range	0.286–0.292	0.246–0.249	0.326–0.347	0.295–0.302	0.303–0.308	0.238–0.263
Average	0.289	0.248	0.337	0.298	0.306	0.251
Shearing yield strength at 0.2 percent offset, p.s.i.						
Range	4740–5460	4040–4420	7230–8000	5610–5820	5840–5920	4540–5150
Average	5100	4180	7720	5700	5880	4850
Shearing yield strength at 0.05 percent offset, p.s.i.						
Range	3180–3980	2760–3340	5840–6700	3960–4400	4460–4580	3420–4290
Average	3580	2960	6340	4120	4520	3860
Modulus of rupture in torsion, p.s.i.						
Range		4940–5110	9630–9960	6740–7120		4670–5680
Average	6720[a]	5060	9800[b]	6980	8400[a]	5180
Approximate rate of strain, in./in./min.	0.015	0.016	0.014	0.015	0.015	0.016

[a] One specimen.
[b] Two specimens.

tively. The average shearing modulus of elasticity, G as determined from a torsion test was found to vary from 248,000 to 337,000 p.s.i., depending on the resin and molding pressure used, and the average modulus of rupture varied from 5060 to 9800 p.s.i., depending on the resin and molding pressure. The data in Table IV show that the shearing modulus of elasticity, modulus of rupture and yield strengths were higher for compreg molded under 1500 p.s.i. pressure than for compreg molded at 600 p.s.i. This was true for each of the three resins. The increase in modulus of rupture was particularly marked. The increase in shearing modulus of elasticity resulting from increasing the molding pressure from 600 to 1500 p.s.i. was 16.5 percent with resin A, 13.1 percent with resin B and 21.9 percent with resin C. The corresponding increases in modulus of rupture were 32.8 percent for resin A, 40.4 percent for resin B and 62.1 percent for resin C. The yield strengths at 0.2 percent offset were increased 22.0, 35.4 and 21.2 percent for resins A, B and C, respectively; and the yield strengths at 0.05 percent offset were increased 21.0, 53.9 and 17.1 percent for resins A, B and C, respectively.

Mode of failure

Fractured tension, compression and torsion specimens are shown in Fig. 10; tension specimens are shown in Fig. 10a. One of the straight tension specimens shows the type of failure which frequently occurred at the shoulder.

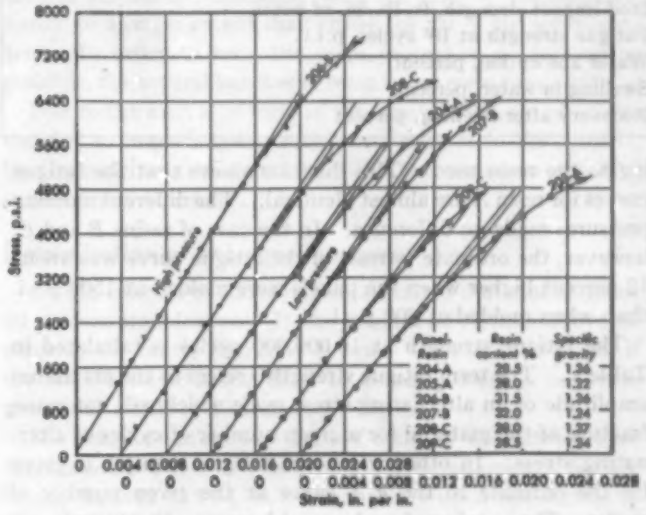
Short compression specimens are shown in Fig. 10b. These failures started as shear failures at 45 degrees to the axis of loading. The long compression specimens, Fig. 10c failed initially in much the same manner as the short specimens. It was observed that the shear failures which are visible in the picture did not occur until after maximum load was passed. Slight bulging was noted as maximum load was reached.

A failed torsion specimen is shown in Fig. 10d. This specimen has been severely twisted to show the type of fracture. The initial fracture in each torsion specimen was a slight longitudinal crack resulting from the shearing stress parallel to the axis of the specimen. The crack was parallel to the grain.

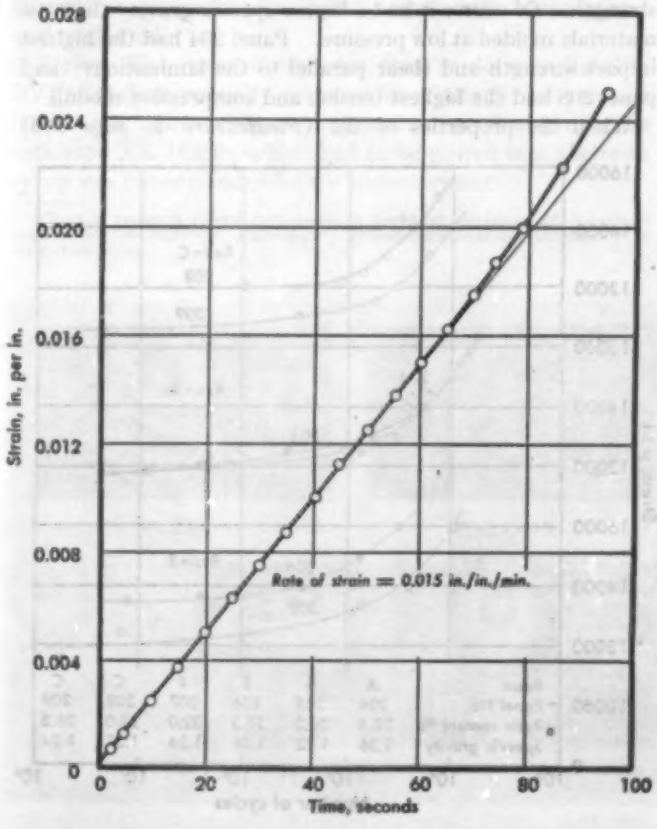
Fatigue tests

The data obtained from the fatigue tests of the six compreg panels are shown in Fig. 11 plotted as σ-N diagrams. The tests were carried out to at least 10,000,000 cycles. It was observed that the fatigue test results were nearly the same for four out of the six panels. The panel made with resin B and molded at the high pressure had the best fatigue characteristics and the panel made with resin C and molded at low pressure had the poorest fatigue characteristics.

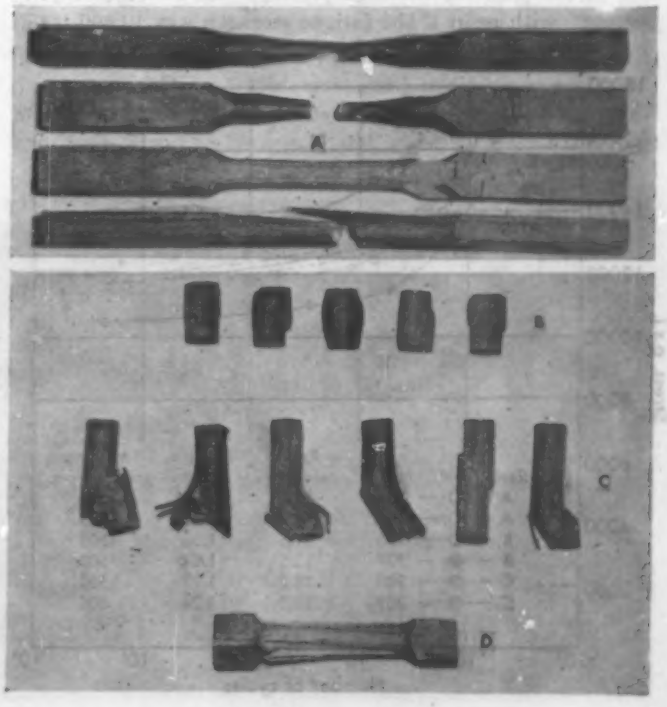
Figure 12 shows the fatigue curves grouped in pairs accord-



9—The shearing stress versus the shearing strain data for torsion tests as expressed in a series of curves



8—A curve of time versus shearing strain which was determined from the torsion tests made on the specimens



10—Four types of fractured specimens: (A) tension, (B) short compression, (C) long compression, (D) torsion

TABLE V.—SUMMARY OF PROPERTIES OF COMPREG PANELS *

	Resin A		Resin B		Resin C	
	Panel 204	Panel 205	Panel 206	Panel 207	Panel 208	Panel 209
Molding pressure, p.s.i.	1500	600	1500	600	1500	600
Specific gravity	1.36	1.22	1.36	1.24	1.37	1.24
Tensile modulus, 10^6 p.s.i.	4.12	3.72	4.20	3.92	4.23	3.88
Tensile strength, p.s.i.	53,700	43,600	54,600	43,500	51,300	47,900
Compressive modulus, 10^6 p.s.i.	4.21	3.81	4.17	4.07	4.33	3.94
Compressive strength, p.s.i.	24,200	22,700	26,800	25,200	24,500	23,800
Compression yield strength at 0.2 percent offset, p.s.i.	20,700	19,000	21,900	21,000	21,600	19,900
Torsion (shearing) modulus, 10^6 p.s.i.	0.289	0.248	0.337	0.298	0.306	0.251
Modulus of rupture (torsion), p.s.i.	6720	5060	9800	6980	8400	5150
Shearing (torsion) yield strength at 0.2 percent offset, p.s.i.	5100	4180	7720	5700	5880	4850
Shear strength parallel to laminations, p.s.i.	4840	3640	4450	4230	4340	3620
Izod impact strength, ft.-lb./in. of notch	10.0	8.3	7.8	6.1	9.4	6.6
Fatigue strength at 10^7 cycles, p.s.i.	11,800	11,800	13,400	12,000	12,000	10,600
Water absorption, percent	3.0	7.0	1.7	5.0	2.0	6.7
Swelling in water, percent	14.2	13.8	9.7	9.9	11.5	12.2
Recovery after swelling, percent	2.90	2.97	1.87	2.22	2.28	2.00

ing to the resin used. This diagram shows that the fatigue curves for resin *A* are almost identical. The different molding pressures made no difference. In the case of resins *B* and *C*, however, the ordinate (stress) of the fatigue curve was about 12 percent higher when the panels were molded at 1500 p.s.i. than when molded at 600 p.s.i.

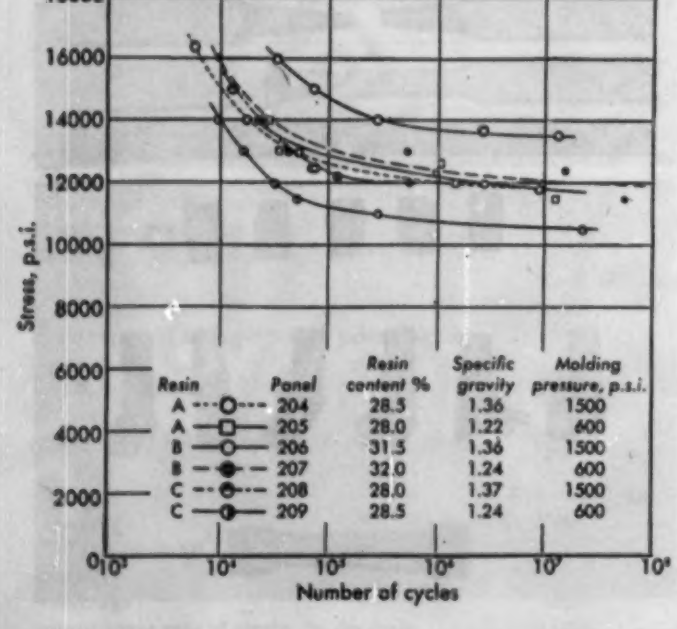
The fatigue strength at 10,000,000 cycles is tabulated in Table V. The term fatigue strength[13] refers to the maximum amplitude of an alternating stress cycle which will not cause fracture of the material for a given number of cycles of alternating stress. In other words the fatigue strength is given by the ordinate to the σ-N curve at the given number of cycles. The number of cycles used here was 10,000,000.

The fatigue strength at 10,000,000 cycles was 11,800 p.s.i. with resin *A* for both molding pressures; with resin *B* the fatigue strength was 12,000 p.s.i. for the low molding pressure and 13,400 p.s.i. for the high pressure—an increase of 11.7 percent; with resin *C* the fatigue strength was 10,600 p.s.i. for the low pressure and 12,000 p.s.i. for the high pressure—an increase of 13.2 percent.

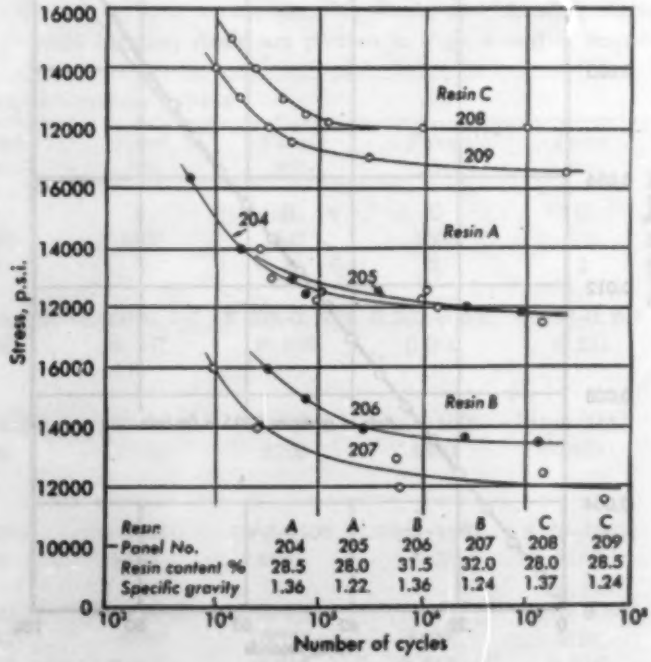
Comparison of results

Average values of all properties determined for the six panels are summarized in Table V. A study of this table discloses that panel 206, molded at 1500 p.s.i. with resin *B*, was outstanding in nine out of fourteen properties tabulated. The last item, recovery after immersion in water, was difficult to evaluate in this manner and will not be included in the comparison. Panel 206 was next to the highest in tensile modulus, compression modulus and shear strength parallel to the laminations, but was fourth from the highest in impact strength. Of course it had a higher specific gravity than the materials molded at low pressure. Panel 204 had the highest impact strength and shear parallel to the laminations; and panel 208 had the highest tension and compression moduli.

When the properties of the (*Please turn to page 196*)


Stress, p.s.i.
Number of cycles
Resin | Panel | Resin content % | Specific gravity | Molding pressure, p.s.i.
A | 204 | 28.5 | 1.36 | 1500
A | 205 | 28.0 | 1.22 | 600
B | 206 | 31.5 | 1.36 | 1500
B | 207 | 32.0 | 1.24 | 600
C | 208 | 28.0 | 1.37 | 1500
C | 209 | 28.5 | 1.24 | 600

11—*Data obtained from the fatigue tests of the six compreg panels. Test results were almost alike for four*


Stress, p.s.i.
Number of cycles
Resin C
208
209
Resin A
204
205
Resin B
206
207
Resin | A | A | B | B | C | C
Panel No. | 204 | 205 | 206 | 207 | 208 | 209
Resin content % | 28.5 | 28.0 | 31.5 | 32.0 | 28.0 | 28.5
Specific gravity | 1.36 | 1.22 | 1.36 | 1.24 | 1.37 | 1.24

12—*Fatigue curves grouped in pairs according to resin used. Fatigue curves for resin A are almost identical*

Fabrics for laminates

by RALPH N. PRINCE and JOSEPH SEIBERLICH*

WHAT effect do certain pretreatments of fabrics have on the properties of laminates? What difference is found in laminates made from a given fabric when it contains moisture and when it is dry at the moment of resin impregnation? How does water absorption change with resin content? In what manner is the tensile strength affected? Is there a relationship between fabric construction and warping, fabric construction and drawing, or moisture absorption and warping? What happens if a laminate is aged by heating?

One fabric, Style P-18, had been widely accepted in the laminating field. Would pretreatments make this fabric better? Would a different style weave be more satisfactory? An investigation was undertaken to answer these questions.

Materials used

Fabrics—A series of seven different styles of fabrics was available for study, each style represented by two or more samples. Some fabrics were in the grey state, some were desized and washed, others had been mercerized or sanforized, and some had been dewaxed. Table I was prepared with a view to presenting the construction and pretreatment of the various fabrics in such a manner that comparisons can be readily made. Figure 1 shows the construction of a representative sample of each of the seven styles of goods used.

If multi-ply laminates had been used, many properties of the several types of fabrics would have had small differentials. By using single-ply specimens, the small differences between fabrics were exaggerated sufficiently for them to be recognized and evaluated.

Resins—The resin chosen for this work was Bakelite BV-16238 clear, specially prepared for relatively low-pressure laminating. In using it, about 2 percent of a highly alkaline catalyst—XK-16253—which had to be stirred into the resin syrup was recommended by the manufacturer.

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Several batches of the above resin syrup, no two of which had exactly the same physical properties, were required for the impregnating work. The pH varied slightly, being between 9.0 and 10.5. Among batches, the most constant component was the solids content. This was found to be about 86 percent for all shipments received. The constancy of this component seemed to indicate that the resin syrup was standardized on a solids content basis. The viscosity of the several shipments, obtained with an outflow viscosimeter, varied to a larger extent than either the pH or the solids content. In order to keep the resin properties as uniform as possible, the several batches of resin syrup were combined.

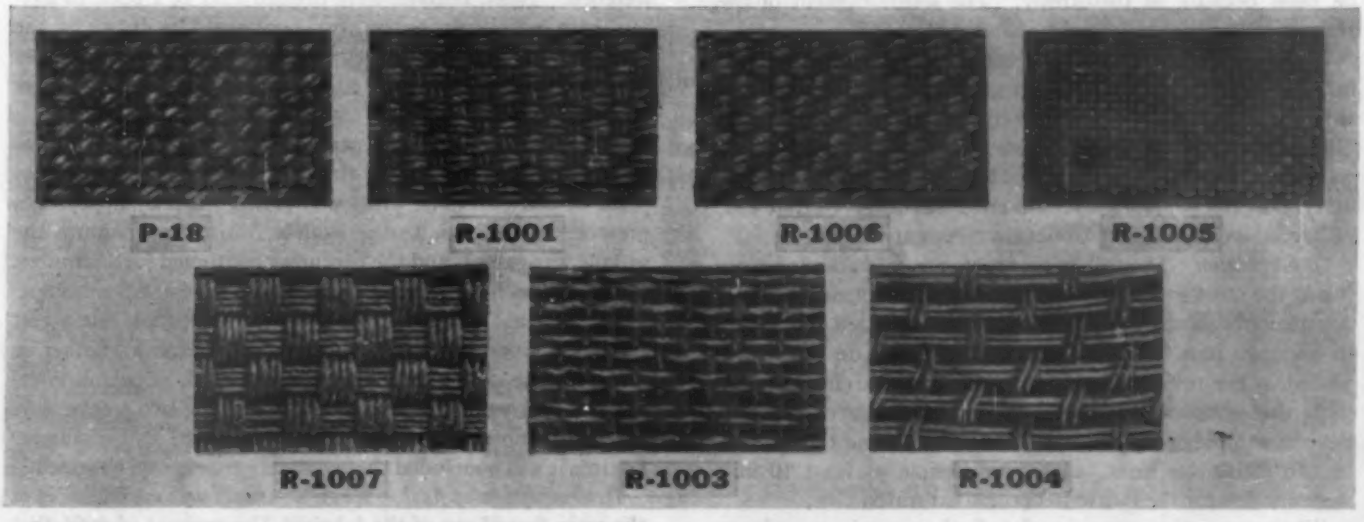
Due to the high alkalinity of the regular resin syrup, it was decided to make a comparative test with resin BVV-16887, having a pH adjusted to 7.0. With this resin, no auxiliary catalyst was necessary.

Determination of impregnation cycle

A resin content of the cured impregnated material of about 50 percent was desired. If the amount of resin is above 60 percent, the fabric character is lost. On the other hand, if the resin content is less than 40 percent, there is too little present to result in a satisfactory bond.

The relative saturation rates of some of the fabrics were determined. The test was conducted by allowing a sample having an area of 5 sq. in. to float freely upon the surface of the resin syrup. The time required for complete visual saturation was taken as a measure of the rate of resin pickup. This varied from 2 to $7^1/_2$ minutes. A minimum impregnating time of 10 min. was established to allow all of the occluded air to escape. No appreciable difference was noted in the final resin pickup even if the impregnating time was 24 hours.

Tests made with small swatches of impregnated fabrics dried at 260° F. for 5 min. were compared with others dried at 175° F. for 15 minutes. Those dried at the higher temperature were found to be brittle and weak, whereas the latter



1—A representative sample of each of the seven styles of goods studied for effects of certain pretreatments of fabrics on the properties of laminates. The construction of the material is clearly shown in these enlarged segments

TABLE I—DESCRIPTION OF FABRICS

Style	Yarn	Twist	Weight	Caliper	pH[a]	Treatment					
						Grey	Starch	Wax	Mercerized	Sanforized	Bleached
			oz./sq. yd.	in.							
P-18 AC1[b]	28 × 20—2 ply	Regular	8	0.026	7.0	+					
P-18 AE	34 × 27—2 ply	Regular	12 7/8	0.037	6.0			+	+		
P-18 AD	29 × 20—2 ply	Regular	8 1/8	0.025	7.0			+		+	
P-18 C	29 × 22—2 ply	Regular	9 1/4	0.032	7.0					+	
P-18 C3	29 × 22—2 ply	Regular	9 1/4	0.032	7.0			+	+		
R-1001 A[c]	56 × 37 single	Regular	7 7/8	0.025	7.0	+	+	+			
R-1001 B	60 × 36 single	Regular	7 3/4	0.024	6.0			+			
R-1001 BC1	58 × 36 single	Regular	8	0.025	7.0						+
R-1001 BD	58 × 41 single	Regular	8 1/4	0.023	7.0			+		+	
R-1006 A[c]	45 × 49 single	Regular	7 1/2	0.024	7.0	+	+	+			
R-1006 B	48 × 49 single	Regular	7 1/4	0.021	7.0			+			
R-1006 AC1	45 × 49 single	Regular	8 1/4	0.023	7.0	+	+				
R-1006 BD	47 × 52 single	Regular	8 1/4	0.022	7.0			+		+	
R-1005 A[d]	44 × 50 single	Regular	7 7/8	0.018	7.0	+	+	+			
R-1005 B	46 × 48 single	Regular	7 1/4	0.017	7.0			+			
R-1007 A[c]	45 × 49 single	Regular	7 5/8	0.025	7.0	+	+	+			
R-1007 B	45 × 52 single	Regular	6 7/8	0.024	7.0			+			
R-1003 A[f]	29 × 20 single	Hard	4	0.018	7.0	+	+	+			
R-1003 B	31 × 19 single	Hard	3 3/4	0.016	7.0			+			
R-1004 A[g]	30 × 18 single	Hard	4 1/4	0.019	7.0	+	+	+			
R-1004 B	30 × 19 single	Hard	4	0.018	7.0			+			

[a] The pH determined colorimetrically by spot tests. (See Ind. and Eng. Chem., Anal. Ed. *15*, 616, for work on potentiometric pH determinations.)
[b] Regular weave using one 2-ply yarn in each direction.
[c] Regular weave using two single-ply yarns in each direction.
[d] Regular weave using one single-ply yarn in each direction.
[e] Regular weave using four single-ply yarns in each direction.
[f] Regular weave using one single-ply yarn in each direction.
[g] Regular weave using two single-ply yarns in each direction.

were flexible and their strength not noticeably affected.

In order that the fabrics retain, as fully as possible, their initial qualities, a drying temperature of 175° F. was chosen. If the resin itself was quite alkaline, the higher temperature—260° F.—would have increased the tendency to a reaction with the cotton. In addition, cellulose itself tends to break down at approximately 200° F.[1] To transform the resin to a higher degree of polymerization before curing, a short precuring treatment in the press, at curing temperature, was given to compensate for the low drying temperature.

Experimental procedures

Analysis of resin syrup—Two properties of the resin syrup were determined, i.e., pH and viscosity, using an outflow type of viscosimeter. The instrument was standardized with glycerol in order that the viscosities would be reported in centipoises. Care was taken to avoid readings which might be false because of thixotropy. The solids content of the resin syrup was also determined.

Preparation of fabrics—The goods was cut, warpwise, 30 in. long and 8 1/2 in. wide. Each sample was weighed, conditioned by allowing it to come to equilibrium with the atmosphere under which the tests were to be made, and then reweighed. A fabric was considered bone-dry after being heated at 175° F. for 15 hours. However, it was observed that 4 hr. of drying were sufficient to obtain constant weight.

Impregnation—The following procedure was adopted since it was the most suitable for use with the equipment available. A sufficient quantity of resin syrup was catalyzed and placed in an open pan (10 by 14 in.) at 70° F. The fabric was placed in the resin syrup, both sides being carefully wetted with the syrup while immersion was being accomplished. Several samples could be immersed at the same time—three usually being the limit. After immersion, at least 10 min. were allowed for the fabric to become saturated.

When saturation was completed, the sample was drawn out of the pan between two wooden doctors in order to remove the excess resin syrup. (Rubber gloves are recommended for operators handling phenol-formaldehyde resin syrups in the above manner, for the material sometimes causes dermatitis.) After doctoring off the excess resin syrup, the sample was passed through a wringer, the rolls of which were under a constant pressure. The resultant impregnated fabric contained approximately 50 percent resin after curing.

For routine evaluation of resins or fabrics, or for a more extensive study of fabrics for laminating, a laboratory-size impregnating machine should be used. By using such an apparatus, duplication of impregnations is facilitated.

Drying—The impregnated fabrics were weighed and dried, hanging loosely in hot air, for 15 min. at 175° F. It was pointed out previously that this drying method was used to retain, as fully as possible, the initial qualities of the fabrics.

Preparation of sample for curing—Samples of the dried material were cut to 10-in. lengths for curing, and each piece weighed. Next, samples were pressed cold at 1 p.s.i. to flatten them sufficiently so that two lines could be drawn on the surface of each piece. They were then marked with cross lines which made it possible to determine dimensional changes brought about by curing.

Curing—The prepared sample was put between two highly polished plates, and the entire unit placed in the hot press at 330° F. The press was closed, thereby applying a pressure of 3/4 p.s.i. to the sample. After one minute the sample was gassed, and the precuring continued for 4 minutes. Pressure was increased to 70 p.s.i. and held for 3 minutes.

The product appeared to be thoroughly cured, but a test was made upon the cured material to determine whether or not complete curing had been accomplished. Several different samples were refluxed with toluene for two weeks. As there were no changes in the samples at the end of the refluxing, it was concluded that complete curing was obtained.

Determination of flash—When a sample was cured, some of the resin flowed out of the fabric. The amount of resin that was not retained by the fabric, plus the loss in weight due to volatile reaction products, was considered the flash.

[1] Haas, Kunststoffe und Zellwolle *21*, 88 (1939).

After the laminate was removed from the press and cooled, the excess resin was scraped off the edges. The laminate was then weighed. The weight loss from that of the uncured material was considered the weight of the flash.

Water absorption—Due to the fact that the standard 24-hr. water absorption test does not reveal the rate of change of weight during the first few hours, a test was established which would indicate that rate. Small weighed samples of laminates were placed in a beaker containing recently boiled distilled water. After $^1/_2$ hr., the samples were removed from the water, dried by blotting with paper towels and absorbent cloth and weighed. The above procedure was repeated at $^1/_2$-hr. intervals for the first few hours, again at 24 hr., and then at 24-hr. intervals for the duration of the test.

The gain in weight was calculated as a percentage of the original weight and was recorded as the percent increase in weight rather than the percent of water absorbed. Whereas some materials were leached out of the laminates during the water absorption test, it would have been necessary to dry each sample at the proper interval to obtain the base weight of the laminates for calculating the water absorption for that particular interval. Following the completion of each water absorption study, the pH of the water was determined potentiometrically.

Tensile strength—Tensile strengths were determined on a Scott tester by A.S.T.M. method D 76–42.

Draw test—With improvements in low-pressure laminating technique, greater use of laminates having compound curvatures developed. In order to determine how much a fabric could be drawn, an instrument was constructed for the test.

The fabric was clamped tightly over a mold having a square face, in the center of which was a spherical hole. A square 120 mm. on a side was drafted on the test piece with the sides parallel to the warp and filling yarns. The mold was then put in the press with the male spherical part centered on the fabric. The distance between platens of the press was taken as the zero reading. Pressure was applied gradually until the fabric ruptured. It was noted then how much the press had been closed, in what manner the square had become distorted, and where the break had occurred.

The instrument used was made of wood.[2] A similar instrument made of metal and designed to facilitate clamping the fabric in place would decrease the time for test and would afford an opportunity for curing and drawing the material.

Accelerated aging—Accelerated aging was accomplished by placing the laminates in an oven at 175° F. for 5- and 10-day periods. Control tests using untreated fabrics were aged in the same manner. Following the aging, water absorption and tensile strength tests were made. This method aged the laminates by heating only. Further work will require the use of other conditions, such as alternate humid and dry atmospheres, fresh and salt water sprays, and exposure to ultraviolet light.

Experimental work

Run 1—The purpose of Run 1 was to determine some of the physical properties of laminates made from the various fabrics under study when the fabrics contained moisture at the time of impregnation. Atmospheric conditions used were from 72 to 74° F. and from 50 to 77 percent relative humidity.

Typical caliper changes have been tabulated in Table II. P-18 AC1 swelled until it approached that of P-18 AE; the former was grey goods and the latter fully shrunk mercerized goods. The other fabrics swelled less than P-18 AC1. However, it must be remembered that the P-18 style goods was constructed with 2-ply yarns whereas singles were used for all of the others. It had been anticipated that swelling would occur because of the alkalinity of the resin syrup that was used in the experiment.

Style R-1005 goods retained 8 to 10 percent less resin syrup than any of the others. The cured laminates, in this in-

[2] Rayon Textile Monthly *25*, 447–448 (Sept. 1944).

TABLE II.—CHANGES IN THICKNESS OF FABRICS

Sample	*Thickness before impregnation*	*Thickness after impregnation*	*Change in thickness*	*Thickness after curing*	*Change in thickness after curing (based on original fabric)*
	in.	*in.*	*percent*	*in.*	*percent*
P-18 AC1	0.026	0.041	+57	0.024	− 8
P-18 AE	0.037	0.044	+18	0.028	−24
R-1001 A	0.025	0.031	+24	0.021	−16
R-1006 A	0.024	0.031	+29	0.019	−24
R-1005 B	0.017	0.021	−23	0.018	+ 3

TABLE III.—TENSILE STRENGTHS OF SINGLE- AND MULTI-PLY LAMINATES

Sample	*Tensile strength, single-ply*		*Tensile strength, two-ply*		*Tensile strength, four-ply*	
	Warp	*Filling*	*Warp*	*Filling*	*Warp*	*Filling*
	lb./in. width	*lb./in. width*	*lb./in. width*	*lb./in. width*	*lb./in. width*	*lb./in. width*
P-18 AC1	128	95	202	228	376	408
P-18 AE	114	115	170	230	...	386
R-1001 A	131	137	282	214	566	422
R-1001 B	138	69	412	...	592	...
R-1001 BC1	135	83	392	162	624	324
R-1006 A	105	119	304	274	614	472
R-1006 B	152	108	304	232	666	408
R-1006 AC1	137	106	274	214	518	440
R-1005 A	114	132	264	250	496	496
R-1005 B	140	122	...	...	...	...
R-1007 A	156	112	308	274	562	442
R-1007 B	157	89	300	216	644	424
R-1003 A	67	36	148	84	322	226
R-1003 B	88	46	154	88	408*	208
R-1004 A	88	16	...	...	...	...
R-1004 B	93	22	176	...	360	174

* This sample not axially true fillingwise.

stance, had a much rougher surface than the rest. Inasmuch as Style R-1005 was constructed with yarns having a regular twist, as were all of the closely woven fabrics, it appeared that the particular construction used must have been the cause for its low resin absorption.

Three styles of goods were hard to handle. Style R-1004 (Fig. 1) was the most difficult; Style R-1007 ravelled very easily and holes were caused by the spreading of the yarns during processing; Style R-1003 was the least troublesome of the three. These styles, being too hard to handle commercially, were eliminated from the later work.

The rate of water absorption was very fast at first and gradually approached a maximum in about 5 days. More than 50 percent of the total weight increase in a 5-day period was made during the first half hour. Those fabrics containing starch size had a greater water absorption than the corresponding ones in the same style after desizing. However, the fact that a fabric contained a starch size did not mean that the water absorption of the laminate would be greater than any unsized fabric would exhibit. If the fabric had been dewaxed and starch sized, it then exhibited the greatest water-absorbing tendency in its series.

Those fabrics, from which multi-ply laminates of 2 and 4 plies were made, exhibited the same relationships regarding the effect of pretreatment as the single-ply materials. The rate of water absorption was less when several plies were laminated, and the final weight increase was only about 60 percent of that of the single-ply material.

The pH of the water after the absorption work was done was 9.1. Inasmuch as the pH of the catalyst was 9.5, and the resin had been completely cured, the source of the alkali in the water was very likely the catalyst itself.

The tensile strength of the fabrics increased considerably when they were impregnated and cured with the phenolic resin. The strength of grey fabrics increased about 20 percent more than those which had been sanforized. Since there was little difference in the strength per yarn between grey and sanforized fabrics after resin impregnation, it appeared quite possible that the alkaline medium had equalized the characteristics of the base fabrics and that the additional strength increase of the grey fabrics represented the differential due to the alkaline reaction. The tensile strengths of cured laminates were slightly greater than those of the uncured materials. During the test on cured laminates, a slight lightening of the color and a definite stretching were observed just previous to the break.

It had been theorized that multi-ply laminates should have strength properties which would be multiples of the single-ply material. The data in Table III are in fair agreement with the theory. Most of the experimental data on tensile strength studies have been omitted to conserve space.

Run 2—The purpose of experimental Run 2 was to determine the physical properties of laminates when the fabric base was dry at the time of impregnation. The procedure was altered to the extent that the fabrics were dried to constant weight and then impregnated as quickly as possible after being removed from the oven. In all other respects, the run was made like the first one. The data showed that Run 2 gave results comparable to those of Run 1.

Run 3—The purpose of Run 3 was to determine how the water absorption of the various fabrics under study would differ from that observed in Run 1 if the resin syrup was diluted 25 percent with ethanol and no catalyst was used. Upon reducing the resin syrup as mentioned above, the viscosity dropped from approximately 4600 to about 400 centipoises. Solids content dropped from 86.5 to 67.5 percent.

The resin pickup in this run was about 10 to 15 percent lower than that of the previous two. Style R-1005 fabrics took up 4 to 6 percent less resin than any of the others. The impregnated fabric did not darken upon aging as much as in each of the other runs. Color remained light after curing.

The water absorption data indicated that an incomplete curing took place. The laminates took on weight very quickly, but all of them lost some of it after a 2-hr. immersion. With further soaking, the weight gradually increased again. It appeared that the material acted more like an unimpregnated fabric in water absorption and that some of the resin was dissolved in about 2 hr. when the weight suddenly decreased.

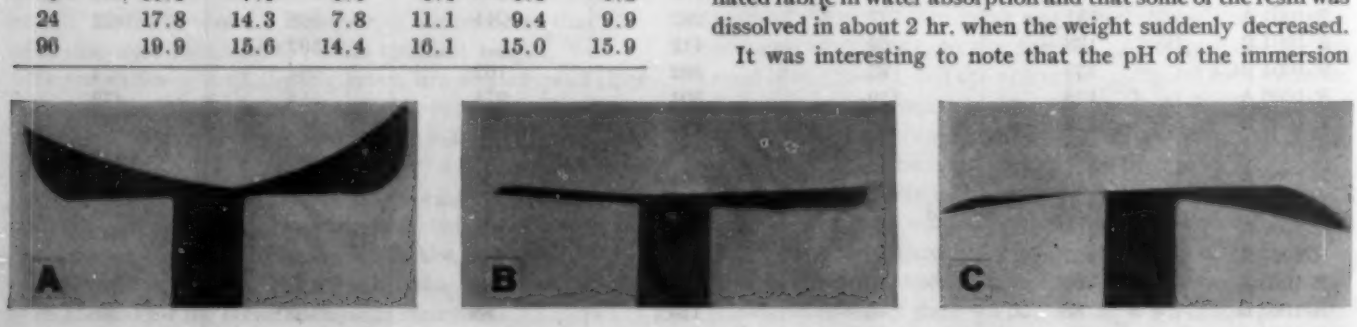
It was interesting to note that the pH of the immersion

TABLE IV.—IMPREGNATION AND CURING DATA FOR RUN 4

Material	*Weight of original fabric*	*Weight of uncured impregnated fabric*	*Weight of cured impregnated fabric*	*Resin content, uncured*	*Resin content, cured*	*Flash*
	gm.	*gm.*	*gm.*	*percent*	*percent*	*percent*
P-18 AC1	30.3	68.6	60.2	55.8	49.7	6.1
P-18 D	31.2	74.7	65.0	58.5	52.0	6.5
R-1001 B	30.6	63.3	55.9	51.6	45.1	6.5
R-1001 D	32.4	66.2	59.8	51.0	45.8	5.2
R-1006 A	29.1	32.1	56.4	53.1	48.4	4.7
R-1006 D	32.5	65.4	57.9	50.2	43.8	6.4

TABLE V.—WATER ABSORPTION DATA FOR RUN 4

Immersion time	*Weight increase on immersion in water*					
	P-18 AC1	*P-18 D*	*R-1001 B*	*R-1001 D*	*R-1006 A*	*R-1006 D*
hr.	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*
1/2	6.0	5.1	2.7	3.6	3.0	2.8
1	6.4	6.0	3.9	3.6	4.1	3.5
1 1/2	7.5	6.0	4.3	5.0	4.5	4.2
2	8.9	7.3	5.5	6.1	5.3	6.0
2 1/2	10.3	7.9	5.5	6.1	5.6	5.2
3	10.3	7.9	5.5	6.1	5.3	5.2
24	17.8	14.3	7.8	11.1	9.4	9.9
96	19.9	15.6	14.4	16.1	15.0	15.9



2—Silhouettes illustrating types of warping. Fabrics shown are: a) R-1001, b) P-18, c) R-1006. Style (b), the only material employing 2-ply yarns, resulted in practically flat laminates, though distorting considerably in curing

water was 8.25 after the water absorption work was completed and the same after boiling for 5 min. with the test pieces. This seemed to bear out the previous thought that the catalyst was gradually leached out of the cured product.

Run 4—The purpose of Run 4 was to determine what effect would result if a neutral phenolic resin syrup was used. For this run, specially prepared resin, BVV-16887, having an approximate pH of 7 and requiring no catalyst, was used. Since only a small quantity of resin was available, only six fabrics were used. The impregnation data are summarized in Table IV and the water-absorption data in Table V.

The laminates, after curing, were colored a yellow, similar in shade to a light chrome yellow pigment. A comparison between Run 4 and Run 1 of the resin retained in the laminates upon curing has shown that the latter was slightly greater. There was only a little difference in the tensile strengths between the two runs. The water absorption was slightly lower in Run 4, and the rate was considerably less for Styles R-1001 and R-1006. The rate of absorption for P-18 fabrics was nearly the same in each run.

Accelerated aging

It was the purpose of these tests to determine what effects would result when laminates were subjected to an aging process which consisted of heating them for 5 or 10 days at 175° F. One grey and one sanforized fabric in each of Styles P-18, R-1001 and R-1006 were used. One set of samples was untreated, one was laminated using Bakelite BV-16238, and one was laminated using Bakelite BVV-16887.

In Table VI the weight increase after immersion in water has been summarized. When Bakelite BVV-16887 was used, the rate of water absorption was very much less after aging. The only exception was the sample of P-18 AC1 which had been aged for 10 days.

It appeared that accelerated aging, carried out in the manner herein described, caused a very slight loss in tensile strength. However, it was found that the strength loss occurred in the fabric, which was resin free.

Draw study

It was one of the objects of this work to determine the degree to which a fabric could be drawn and in what manner it would fail when it was clamped rigidly and forced into a spherical mold. The details of the method used have been described earlier. The experimental data have been summarized in Table VII.

3—Change in warping when yarns are neutralized in one direction shown in two new fabrics. XR consists of single yarns in each direction; XXR has 2-ply warp yarns

The mold that was used was designed in such a manner that any tendency for a fabric to break diagonally could be detected. In no case, however, was a diagonal break observed. The break occurred in the structurally weakest direction.

It may be seen that the preshrunk fabrics could be drawn more than unshrunk ones, and wet fabrics could be drawn more than either of the others. Also, a fabric free-shrunk in each direction could be drawn to the limit of the mold and would return to its original condition upon release of the pressure. But, if the fabric was free-shrunk in only one direction, it would remain relaxed in that direction and the other yarns would fail.

Warping

Throughout the experimental work, one characteristic—the manner in which a laminate warped—was outstandingly different among the various fabrics. In each instance, a given style fabric resulted in a definite type of warping. The three styles, P-18, R-1001 and R-1006, which were most nearly the same in construction, were chosen for an investigation of the warping phenomenon.

When the laminates were removed from the press after curing, the types of warping shown in Fig. 2 occurred immediately. P-18 laminates were practically flat, R-1005 lami-

TABLE VI.—WATER ABSORPTION—ACCELERATED AGING

Immersion time	*Weight increase of specimens aged 120 hr.*						*Weight increase of specimens aged 240 hr.*					
	P-18 AC1	*P-18 D*	*R-1001 B*	*R-1001 D*	*R-1006 B*	*R-1006 D*	*P-18 AC1*	*P-18 D*	*R-1001 B*	*R-1001 D*	*R-1006 B*	*R-1006 D*
hr.	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*
RESIN BV-16238												
1/2	6.5	3.7	3.6	4.6	6.9	3.0	5.2	3.6	4.2	3.7	5.3	5.2
1	8.5	4.6	4.1	5.8	8.4	4.1	7.0	5.1	5.3	5.3	7.7	5.5
1 1/2	9.5	7.6	4.8	6.5	9.2	5.1	7.9	6.1	5.7	5.4	8.7	6.5
2	10.7	8.6	5.3	7.1	9.8	5.3	9.1	6.8	5.9	6.3	10.1	7.3
2 1/2	11.3	9.3	5.4	7.5	10.7	5.7	10.1	6.8	7.1	6.7	10.5	7.5
24	15.1	14.2	12.1	13.0	14.6	11.9	15.1	13.7	13.3	13.7	16.9	13.8
72	14.5	13.8	13.1	13.4	15.6	11.9	14.5	13.4	13.4	14.4	15.8	13.7
96	14.2	13.7	13.8	13.6	14.8	12.2	14.9	13.1	14.0	14.7	16.2	14.6
RESIN BVV-16887												
1/2	2.9	4.2	2.0	2.5	2.9	1.8	6.9	2.8	1.3	3.2	2.2	1.9
1	4.0	5.1	2.8	3.6	3.6	2.6	9.0	3.5	2.1	4.9	3.7	2.7
1 1/2	5.8	6.6	3.5	4.4	4.9	3.2	12.8	5.4	3.3	5.8	4.6	3.6
2	6.2	7.0	3.5	5.0	5.4	3.4	12.2	5.7	3.3	5.8	4.6	4.0
2 1/2	6.6	7.4	4.1	4.8	4.9	3.6	11.1	5.9	2.7	5.6	4.4	4.2
24	13.9	13.3	7.2	7.5	7.8	6.4	14.2	12.6	5.4	9.8	6.3	6.2
72	15.1	14.4	12.2	14.4	13.8	12.7	19.7	14.4	6.1	15.7	8.5	10.9
96	15.3	14.8	13.5	13.0	14.5	12.9	15.1	14.0	12.8	14.6	10.0	10.9

TABLE VII.—DEGREE OF DRAW OF VARIOUS FABRICS

Material	Vertical draw, average	Width of lines at narrowest point, average		Location of failure
		Warp	Filling	
	mm.	mm.	mm.	
P-18 AC1 (dry)	17	111	116	Filling
P-18 AC1 (wet)	30	108	107	Filling
P-18 D	25	108	108	Filling
P-18 D (impregnated)	23	114	111	Filling
R-1001 B	22	110	114	Warp
R-1001 D	26	109	108	Filling
R-1006 A	18	110	114	Warp
R-1006 B	16	113	113	Warp
R-1006 D (heated to 230° F. for one hour)	25	110	110	Warp
R-1005 B	20	112	115	Warp
Free shrink (filling only)	24	114	120	Warp
Free shrink (each direction)	Draw to full extent of mold with no change in fabric			

nates developed a slight U-shaped curling around the warp axis, R-1006 laminates warped slightly, and R-1001 laminates warped to a fairly large degree. Also, R-1006 laminates warped in such a manner that they had to be turned through 90° in order to superimpose them upon R-1001 laminates. In other words, *the warp yarns of the two styles of fabrics had to be crossed in order to have the same curvature of the laminates.*

These results were observed as soon as the materials were removed from the press and before any water had touched them. Multi-ply laminates exhibited the same types of warping though not to as noticeable an extent. After water absorption, the warping was considerably exaggerated.

Since it had been anticipated that a shrinkage would occur during curing, lines were drawn on the uncured samples perpendicular to each other and parallel to the warp and filling yarns. However, curing caused not only an elongation rather than a shrinkage of the material, but it also produced such an internal strain that some of the lines became curved. Typical results are presented in Table VIII.

It may be seen in Fig. 2 that P-18 style fabrics resulted in practically flat laminates even though they exhibited considerable distortion during curing. Also, it may be noted that the only style in which 2-ply yarns were used was P-18. In view of the above, it was apparent that the effect of twisting a yarn upon itself was an important contribution toward the elimination of warping.

According to Harrison,[3] if fibers were doubled and twisted upon themselves and placed loosely in cold water, they gradually straightened. When the fibers were doubled and the free ends were held tightly while twisting, the untwisting was quite fast. However, if the fibers were twisted upon themselves before being doubled, the untwisting took place very slowly. He considered that the torsional stresses could be released only by the untwisting of the free ends.

With the above reference in mind, two fabrics were constructed: One (XR) was equivalent to P-18 except that the yarns were single in each direction; the other (XXR) was similar except that the warp yarns were two ply. Each fabric produced a warped laminate as shown in Fig. 3 but the type of warping differed in a manner similar to that between R-1001 and R-1006.

Whereas the constructions of P-18 and R-1001 differed only in the fact that the former had plied yarns and the latter singles, it was not unexpected that XR and R-1001 warped in a like manner. The resultant of the horizontal and vertical stresses, unless they were neutralized in some manner, would be the same in each fabric. The results indicated that the torsional stresses were neutralized by plying, for when one direction of stress was neutralized by using plied yarns, the distortion changed form due to the change in the resultant force.

In order to determine whether the resin caused the warping, samples of the plain fabrics were put through the pressing cycle. The characteristic types of warping resulted. It was thought that there might be a tendency for these stresses to relax if the fabrics were kept in a moist atmosphere for a few days. However, after ten days' conditioning, there was no change. Again, the characteristic warping developed to an exaggerated amount in the plain fabrics and in the laminates when accelerated aging with heat was tried.

The data have led to the conclusion that the *construction* of a fabric has a far greater effect upon its warping characteristics than water absorption.

Summary

In summarizing the present work, it should be pointed out that the investigation was not an exhaustive one but the initial attempt to determine some of the factors which contribute to the production of fabrics suitable for laminating. It is believed that the experimental procedure could be used to advantage by laminators and fabric manufacturers in choosing materials for laminating.

The loosely woven fabrics were so difficult to handle that the only probable practical use might be the one where they could be wrapped around a mold and subsequently impregnated with resin by paintbrush methods. Such fabrics did appear to absorb a little more resin than the others.

After a fabric appeared thoroughly saturated with resin, the degree of resin pickup remained the same even if the time of impregnation was extended for several hours. In general, the grey and sanforized goods retained about the same amount of resin while mercerized goods retained less than that of any other pretreated material tested. Those fabrics in the R-1005 series consistently absorbed about 10 percent less resin than any of the others.

Although all of the fabrics swelled when impregnated, those having 2-ply yarns did so to the greatest degree while those which had been mercerized swelled the least. Probably the caliper changes were caused by the high alkalinity of the resin syrup used.

There was a definite increase in the tensile strengths of all fabrics when they were impregnated, and a smaller increase was observed after curing. Upon aging by heat, a very slight decrease in tensile strength occurred which was a loss in fabric strength only. There was little difference in the final strength between grey and sanforized goods after impregnation even though the increase (*Please turn to page 196*)

TABLE VIII.—BEHAVIOR OF RESIN-IMPREGNATED FABRICS DURING CURING

Material	Elongation		Deviation of Line		Warping
	Warp	Filling	Warp	Filling	
	percent	percent	mm.	mm.	
P-18	0.35	0.77	1.5	0	No
R-1001	0.30	0.37	2.0	0	Yes
R-1005	0.00	0.00	0	0	Yes
R-1006	0.00	0.37	0	0	U-shaped curvature

[3] Proceedings of the Royal Society Vol. A, 94 (1918).

←Cost of finished pieces was reduced 40% by this RCA preheating unit at Kellogg Switchboard and Supply Company.
Telephone "cradle" molded by Kellogg; with cold molding, 4 press cycles per hour—with electronic preheating, 6¼ cycles.

Kellogg Switchboard Reduces Cost 40% with Electronic Heat

Press Output Increased 56%; Molding Pressure Lowered; Warpage and Blistering Reduced with New RCA Automatic Plastics Preheater

Application: Kellogg Switchboard and Supply Company, Chicago, compression-molds a large quantity of telephone parts, including the "cradle" shown above. A four-cavity mold is used; each cavity takes 2 preforms weighing 1.75 ounces each. Material: Bakelite BM 2498. Molding Temperature, 320°F.

To step up production on this part, the Kellogg Switchboard and Supply Company installed RCA electronic preheating equipment. The complete charge of 8 preforms per mold is now preheated for 35 seconds to a uniform temperature of 220°F.

According to Mr. W. G. Cregeen, Assistant Shop Superintendent of the Kellogg Plant, electronic heating reduced the cost of finished pieces by 40%, and warpage and blistering, which were previously problems, are no longer troublesome.

	Cold Molding	Electronic Molding
Press Closing Time	1 min.	1 min.
Curing Time in Mold	5 min.	2½ min.
Press Cycles per Hour	4	6¼
Molding Pressure	125 psi	75 psi
Mold Damage		Less
Mold Life		Increased
Dimensional Tolerances and Stability		Better

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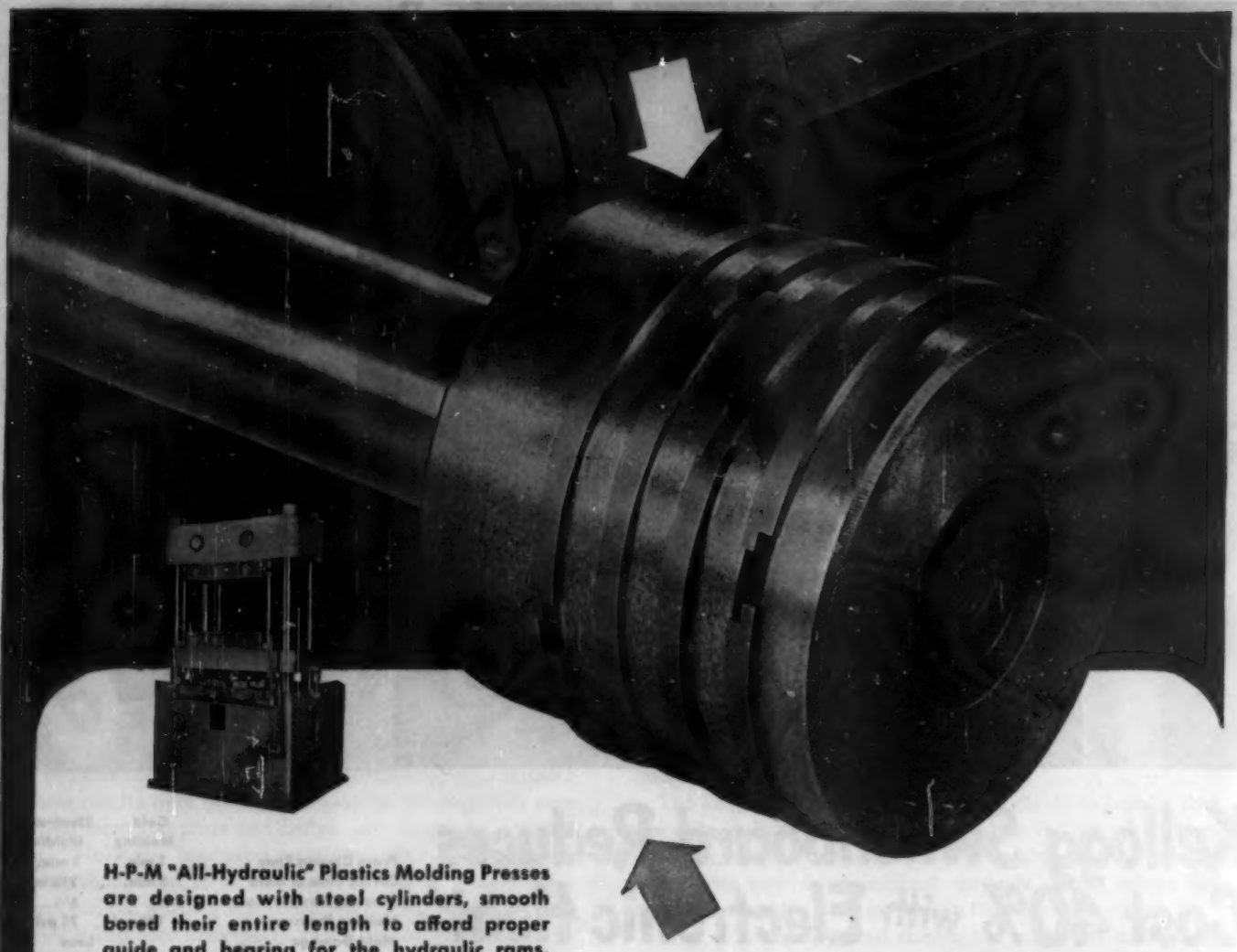

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TECHNICAL BRIEFS

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments.

Engineering

SWELLING OF PLASTIC BEARINGS. Plastics (London) *9*, 235-7 (May 1945). This is a condensation of an article which was published in Kunststoffe *34*, 27 (1944). The swelling characteristics of phenolic plastic bearing materials filled with coarse cotton fabrics, fine cotton fabrics, cotton fabric clippings and cellulose fibers were investigated. The experiments were made with distilled water. The process of swelling started at the outer zones of the specimens which were subjected to attack from both sides. The swelling was not uniform; there were distinct spots where swelling was more pronounced than at others. The swelling of the cotton fabric laminates was considerably less than that of the molded materials containing pieces of fabric. The swelling of the materials filled with cellulose fibers was less than that of the laminates. The differences within specific groups were so markedly different that few general conclusions may be made.

Chemistry

THE POLYMERIZATION OF ALLYL COMPOUNDS. I. FACTORS GOVERNING THE ACYL PEROXIDE-INDUCED POLYMERIZATION OF ALLYL ACETATE, AND THE FATE OF THE PEROXIDE. P. D. Bartlett and R. Altschul. J.A.C.S. 67, 812–16 (May 1945). Allyl acetate is polymerized by heating with acyl peroxides at 80° C. to a polymer whose molecules contain an average of about 13 monomer units. The rate of polymerization is reproducible and is not affected strongly by oxygen unless the solution is vigorously agitated with oxygen or air during polymerization. Water, hydrogen chloride and pyridine in small amounts do not affect the rate. When the polymerization is induced by 5.9 percent by weight of *p*-chlorobenzoyl peroxide, 72.5 percent of the chlorine originally present in the peroxide appears in end-groups permanently attached to the polymer, 16.8 percent appears as free, unattached benzoic acid, and 10.7 percent is unaccounted for. Out of the 72.5 percent in the form of end-groups, definitely 52 percent and probably 60.5 percent of the original chlorine is in the form of *p*-chlorobenzoate groups, 12 percent as *p*-chlorophenyl groups. Chain transfer occurs to the extent of 23 percent. The amount of carbon dioxide evolved from the acyl peroxide depends upon the solvent, temperature and presence of oxygen, but not upon the average concentration of monomer which occurs during the process of polymerization.

THE POLYMERIZATION OF ALLYL COMPOUNDS. II. PRELIMINARY KINETIC STUDY OF THE PEROXIDE-INDUCED POLYMERIZATION OF ALLYL ACETATE. P. D. Bartlett and R. Altschul. J.A.C.S. *67*, 816–22 (May 1945). The decomposition of benzoyl peroxide in allyl acetate as solvent is very nearly unimolecular, the rate constant at 80° C. varying from 0.191 to 0.235 per hour over a tenfold range of initial peroxide concentration. The concentration of monomer is a linear function of the concentration of peroxide over the entire course of a polymerization. The value of the ratio of concentration of monomer to concentration of peroxide shows some dependence upon the initial peroxide concentration, changing from 28.8 with 1.01 percent by weight of peroxide to 15.6 with 9.95 percent by weight of peroxide, but the average degree of polymerization of the polymer is 13.4 ± 0.4 in all cases. The constancy of the ratio of concentration of monomer to concentration of peroxide during a polymerization is interpreted as meaning that the polymerization chain is broken by collision of a growing free radical with a monomer molecule to yield a new, stabler free radical which is usually incapable of propagating the chain. This process is designated as "degradative chain transfer." Unimolecular reactions in an expanding or contracting medium are best treated in terms of concentrations per unit weight, and not per unit volume of the medium. It is also convenient to treat certain bimolecular reactions in terms of weight-concentrations of the species whose change in concentration is being considered. The polymerization of allyl chloride at 80° C. by benzoyl peroxide yields a polymer containing an average of 6.3 monomer units per molecule. On an average, 5.8 such molecules are produced by the decomposition of each peroxide molecule.

PRODUCTION OF VINYL ACETATE FROM ACETYLENE AND ACETIC ACID IN THE PRESENCE OF THE MERCURY SALTS OF COMPLEX FLUORINE ACIDS. B. S. Groth and S. B. H. Johanson. The Svedberg (Mem. Vol.) *1944*, 288-98. Mercury salts of complex acids formed from orthophosphoric, orthoarsenic, or orthostibinic and hydrofluoric acids were investigated as catalysts for the reaction of acetylene with acetic acid to form vinyl acetate. The complex acids are readily prepared in the reaction mixture. The absence of water in the reaction mixture is important. The yields of vinyl acetate, based on amount of acetylene consumed, were approximately 85 percent.

NOTE ON THE KINETICS OF SYSTEMS MANIFESTING SIMULTANEOUS POLYMERIZATION-DEPOLYMERIZATION PHENOMENA. P. J. Blatz and A. V. Tobolsky. J. Phys. Chem. *49*, 77-80 (Mar. 1945). The kinetics for a simple case of simultaneously occurring polymerization-depolymerization reactions are discussed. Expressions are derived in terms of a size-independent bimolecular polymerization rate constant and a unimolecular depolymerization rate constant for extent of reaction and number average degree of polymerization. Detailed application of the kinetic equation is not made because of insufficient experimental data on reactions of this type.

THE REACTIONS BETWEEN PROTEINS AND FORMALDEHYDE. R. L. Wormell and M. A. G. Kaye. J. Soc. Chem. Ind. *64*, 75-80 (Mar. 1945). Proteins belonging to the class of animal and plant caseins have been deamided by treatment with warm dilute caustic soda solution. The deamidocaseins are compared with the untreated caseins as regards combination with formaldehyde in the presence of salt and acid. Caseins hardened in aqueous formaldehyde at pH4, and then treated with salt, acid and formaldehyde also, are compared as regards formaldehyde content. A few experiments have been carried out on zein, edestin and deaminated casein. It is concluded that, under acidsaline conditions, formaldehyde combines with the amide groups present in proteins. The theoretical implications of the above conclusions are discussed.

POLYMERIZATION OF STYRENE UNDER VARIOUS EXPERIMENTAL CONDITIONS. J. Abere, G. Goldfinger, H. Naidus and H. Mark. J. Phys. Chem. *49*, 211-25 (May 1945). Polymerization of styrene was carried out in various solvents (particularly toluene, methanol and carbon tetrachloride) with various amounts of benzoyl peroxide as catalyst at 60 and 100°C. in various concentrations of the monomer. The initial over-all rate of the polymerization increases with monomer concentration somewhat faster than simple proportionality would require. A method is indicated to

show how intrinsic viscosities of the polystyrene samples obtained can be used to estimate the number average polymerization degree. The initial number average polymerization degree can be expressed in terms of three rate constants: rate of propagation, termination and chain transfer. The influence of the solvent on chain transfer is discussed. The polymerization in methanol shows certain irregularities which are presumably due to the formation of a gelatinous phase during polymerization.

THE REACTION OF FORMALDEHYDE WITH PROTEINS. H. Fraenkel-Conrat, M. Cooper and H. S. Olcott. J. A. C. S. *67*, 950-4 (June 1945). Formaldehyde combines with both the primary amino and the primary amide groups of proteins in 4 percent solution at a pH of 3 to 7 and 70°C. The secondary amide linkages of the peptide chain and the phenolic groups do not combine with appreciable amounts of formaldehyde. These conclusions were confirmed with protein derivatives and synthetic polypeptides containing a maximal or minimal number of reactive groups. The preparation of a polypeptide rich in primary amide groups from polyglutamic acid is described.

Properties

CELLULOSE ACETATE FRACTIONS. A. M. Sookne and M. Harris. Ind. Eng. Chem. *37*, 475–7 (May 1945). The intrinsic viscosities and osmotically estimated number-average molecular weights of a series of cellulose acetate fractions were measured. Within the range of chain lengths investigated (number-average molecular weight up to 130,000), the number-average molecular weights are proportional to the intrinsic viscosities in acetone solutions, in agreement with Staudinger's rule and the results of Kraemer. An estimate is provided of the relative homogeneity with respect to molecular size of the fractions and the material used in preparation.

THE MELTING OF POLYTHENE. R. B. Richards. Trans. Faraday Soc. *41*, 127-37 (Mar. 1945). The melting-points of polythene samples are normally 20 to 30°C. below the value expected for a pure linear paraffin of comparable chain length, the melting process extends over a much wider temperature range, and the solid is not entirely crystalline even at room temperature. Samples with the same average molecular weight, as indicated by intrinsic viscosities, can vary as much as 15° in melting point. These variations may be due to changes in molecular weight distribution and in the degree of chain branching. By an extension of the statistical thermodynamic treatment of Frith and Tuckett, an equation is derived for the variation, with temperature of the degree of crystallinity of a long chain linear paraffin containing various proportions of short chain paraffinic liquids which are concentrated in the amorphous regions of the solid. From this equation a further equation is derived for the change of melting-point with the proportion and molecular weights of the added liquid. The theoretical results are found to be in fair agreement with observed data for the depression of melting-point by paraffins of various molecular weights. The theoretical results suggest that there should be a connection between the crystallinity, and hence density, of the solid at ordinary temperatures and the melting point of the sample; this is shown to be in accord with observed data. The presence of side groups will have an effect similar to that of short molecules, and by increasing the entropy of the amorphous regions will lead to a more amorphous polymer. Part of the variability in melting point and crystallinity in polythene is due to variation in degree of branching.

CREEP PROPERTIES OF MOLDED PHENOLIC PLASTICS AT ELEVATED TEMPERATURES. W. J. Gailus and D. Telfair. Trans. A. S. M. E. *67*, 253-8. (May 1945). Tension creep data of molded phenolic plastics at 192°F. for periods up to 1000 hr. and recovery data up to 250 hr. are reported. Modulus of elasticity values were obtained at the beginning and end of the 1000-hr. tests. Studies included the effect of moisture content on creep properties. The materials investigated included molded phenolics with wood flour, chopped canvas (rag) cotton cord, asbestos and mica fillers, unfilled phenolic resin and two types of paper laminate (both cross-laminated). The total creep in 1000 hr. and creep rate (in percent per 1000 hr.) depend to a considerable degree upon the type of filler used in molded phenolic plastics. The creep of inorganic materials is much less than that of materials with organic fillers of the cellulose type. Continued heating has tremendous effects on the creep properties of phenolic plastics. Extension caused by the load is largely compensated by contraction resulting from the shrinkage. Cellulose-filled materials show an especially large amount of shrinkage. The long-time tensile strength at 192°F. varies roughly from 18 to 25 percent of the short-time tensile strength at room temperature depending upon the filler used. Modulus of elasticity in tension increases 25 to 50 percent after continued heating at 192°F. for 1000 hr., depending upon the type of filler used. The relation between stress and creep rate is linear in a log-log plot for mineral-filled phenolics.

EFFECT OF SOME ENVIRONMENTAL CONDITIONS ON THE MECHANICAL PROPERTIES OF CELLULOSE ACETATE AND CELLULOSE NITRATE PLASTIC SHEETS. T. S. Lawton, Jr., T. S. Carswell and H. K. Nason. Trans. A. S. M. E. *67*, 23-30 (Jan. 1945). The effect of ambient temperature, relative humidity, testing speed and sheet thickness on the tensile properties, and of temperature on the compressive, flexural, shear and impact properties of cellulose acetate and cellulose nitrate plastic sheets is shown and the nature of the effects summarized.

Testing

A BALL IMPACT TESTER. C. R. Stock. A.S.T.M. Bulletin No. *130*, 21–6 (Oct. 1944). This paper describes an impact testing apparatus which makes use of a set of steel balls of graded weights, from which may be selected one which, after gravitational acceleration down inclined rails, strikes a test specimen horizontally and utilizes all, or almost all, of its kinetic energy in fracturing the specimen. The construction, calibration and operation of the apparatus are described, as well as the sources, reduction and calculation of the magnitudes of several errors, both inherent and experimental. Data are given for several types of thermosetting molded plastics, comparing results obtained by the present A.S.T.M. Tentative Methods of Test for Impact Resistance of Plastics and Electrical Insulating Materials (D256–43T, 2 ft.-lb. pendulum) with results obtained using the methods described in this paper. Discrepancies in magnitude of the values obtained are pointed out. Other data illustrate the lower dispersion of results as well as the improved sensitivity obtainable with the latter method.

IDENTIFICATION OF RAW AND VULCANIZED RUBBERLIKE POLYMERS. I. "REACTION TIME" IN A MIXTURE OF NITRIC AND SULFURIC ACIDS. L. F. C. Parker. J. Soc. Chem. Ind. *63*, 378–9 (Dec. 1944). The time taken for the start of disintegration of natural and certain synthetic rubbers in a mixture of nitric and sulfuric acids is used as a simple and reliable aid in the identification of an unknown rubber. With Perbunan, Buna-S, and butyl types of rubber, this test seems sufficient to establish identity, but other types, including chloroprenes, thioplasts and natural rubber, require additional data. Indication is also given of ratios of quantities in binary mixtures of known "rubbers." The test is one not requiring a chemical laboratory or special personnel.

A NEW MACHINE FOR MEASURING WEAR RESISTANCE OF WALKING MATERIALS. A. W. Cizek, Jr., D. H. Kallas and H. Nestlen. A.S.T.M. Bulletin No. *132*, 25–8 (Jan. 1945). The design and performance of a wear testing machine are described. The design permits independent control of such factors in wear testing of walking materials as speed, amount of lift of specimen, amount, size and kind of

abrasive, material on the face of the abrasive disk, ratio of specimen shaft speed to abrasion disk speed, size of specimen, configuration of specimen and load on the specimen. This versatility of control facilitates production of the combination of conditions nearest actual service.

A TESTING MACHINE FOR PLASTIC BEARINGS. H. Conradt. Plastics (London) *9*, 185–8, 206 (Apr. 1945). This article is based on two articles which appeared in Kunststoffe *33*, 270 (1943) and *34*, 79 (1944). A machine for testing plastic bearings is described.

IDENTIFICATION OF RAW AND VULCANIZED RUBBERIZED POLYMERS. II. DETERMINATION OF SELLING RATIOS. L. F. C. Parker. J. Soc. Chem. Ind. *64*, 65-7 (Mar. 1945). The ratios of the swellings of vulcanized rubberlike polymers in benzene, petroleum ether (boiling point 40 to 60°C.) and aniline at 25°C. are different for different polymers. They are within a well-defined narrow range for each player. The ratios are substantially independent of the state of vulcanization and the nature and amount of the fillers. This property may be used to identify unknown samples of the various polymers. It is necessary to remove softeners, extenders and similar materials with acetone before making the swelling tests. Two plots are given showing the swelling limits of many rubberlike polymers. This technique may also be of assistance in identifying mixtures of rubbers. It is shown that although Gee's theory of swelling is not in complete agreement with the results of experiment, the theory, under certain restrictive conditions, does explain the data reported.

USE AND EVALUATION OF SOME SPECIALTY ADHESIVES. F. Wehmer. Mechanical Eng. *67*, 380-2 (June 1945). Various methods for testing adhesives are described in this article.

THE EFFECT OF SPECIMEN SHAPE ON THE COMPRESSIVE STRENGTH PROPERTIES OF LATERALLY SUPPORTED PLYWOOD SPECIMENS. J. A. Liska. A. S. T. M. Bull. No. 133, 33-6 (Mar. 1945). Prism-shaped specimens have commonly been used for compression tests of wood and plywood, but hourglass-shaped specimens have been considered as possibly giving more reliable results because of improved end conditions and type of failure. This report presents the results of two series of tests performed at the Forest Products Laboratory to compare two forms of hourglass specimens (designated as types *A* and *B*) with prism-shaped specimens (designated as type *C*). In the principal series of tests, the specimens were all prepared in the normal manner with smooth ends, but the second series was designed to afford a comparison of the prism-shaped specimens (type *C*) with the hourglass specimens (type *B*) when the specimens were made with deliberately chipped and frayed ends, such as might be produced by poor fabrication. The analysis of tests made on 200 specimens of two species and three plywood thicknesses and constructions, indicated that despite a difference in the mode of failure, the physical properties of the well-prepared prisms were in good agreement with those obtained on the two forms of hourglass specimens, and were slightly higher when small differences were noted. When the faces of the specimens were chipped and torn by improper preparation, the prism-shaped specimen (type *C*) shows a definite reduction in compressive strength as compared to well-prepared specimens of the same type and to those of the hourglass (type B) form. Little, if any, difference in fiber stress at proportional limit or modulus of elasticity was observed between the poorly fabricated prisms and hour-glass-shaped specimens (type *B*). In the preparation of prism-type compression specimens, care should be used in fabrication to insure smooth end surfaces. When specimens are carefully prepared, the results of this study show that the prism-type specimens (type *C*) afford satisfactory results.

Synthetic rubber

PREDICTING VOLUME INCREASE OF PERBUNAN COMPOUNDS IN PETROLEUM PRODUCTS. R. M. Howlett. Ind. Eng. Chem. *37*, 223-5 (Mar. 1945). A study was made of the volume increase of Perbunan compounds immersed in various petroleum products. As a result of this work a method was developed for calculating the volume swell of a Perbunan compound when it is immersed in a given petroleum product under certain test conditions. The work of prediction or calculation of volume increase is simplified by the construction of two graphs which may be used with experimentally determined constants of swell and extraction.

SPECIFIC INFLUENCES IN THE POLYMERIZATION OF DIENES. CHEMICAL FACTORS INFLUENCING THE HOMOGENEITY OF SYNTHETIC RUBBERS DURING PRODUCTION. W. S. Penn. India-Rubber J. *107*, 345-8, 373-6 (1944). The chemical factors influencing the homogeneity of synthetic rubbers during production are reviewed and discussed.

EFFECT OF ATMOSPHERIC HUMIDITY ON GR-S. F. E. Rupert and F. W. Gage. Ind. Eng. Chem. *37*, 378-82 (Apr. 1945). The moisture content of the raw polymer was found to have a definite effect on the curing rate of GR-S compounds. Using the GR-S specification recipe, a study of the effect upon the physical characteristics of vulcanizates due to exposure of the mixed stocks to various relative humidities showed good correlation between moisture content of the mixed stock and the curing rate. Little effect on the other physical properties was observed. The rate of moisture absorption of three samples of raw polymers and their compounds was determined. These data show that the presence of only a trace of soap has a marked influence on the rate of moisture absorption.

HIGH TEMPERATURE OVEN AGING OF OIL-RESISTING SYNTHETIC RUBBER COMPOUNDS. G. D. McCarthy, A. E. Juve, H. Boxser, M. Sanger, S. R. Doner, E. N. Cunningham, J. F. McWhorter and R. H. Crossley. A.S.T.M. Bulletin No. *132*, 33-7 (Jan. 1945). Synthetic rubber vulcanizates of all types commercially available today become stiffer when exposed to elevated temperatures in an air oven. An investigation of the effect of varying conditions of high-temperature exposure has shown that at constant temperature the supply of oxygen is the principal factor causing stiffening of the vulcanizates. The loss of volatile plasticizers, when present, also contributes to the stiffening. The test tube technique in which dumbbell samples are suspended in stoppered 38 by 300 mm. test tubes heated by immersion in an oil bath appears to give results which are considerably more duplicable than those obtained by the usual aging in circulating air ovens. The test tube technique also gives somewhat better differentiation between good heat-aging and poor heat-aging compounds. The rate of deterioration as measured by elongation change is doubled for an 18° F. increase in the exposure temperature. As measured by hardness change the rate is doubled by an increase of 42° F.

RECLAIMED SYNTHETIC RUBBER. F. L. Kilbourne. India Rubber World *111*, 687-90, 699 (March 1945). GR-S reclaim possesses physical properties equal to those of natural rubber reclaim, and is less tacky and more inert. While GR-S reclaim takes up pigment load somewhat slower, it can be loaded at least as much as natural rubber reclaim and gives smoother, better tubing products. The absence of alkali in GR-S reclaim results in slower cures which can be offset by lengthening the time of cure, raising the temperature of the cure or increasing the amount of sulfur from approximately 3 parts per 100 of reclaimed rubber hydrocarbon to 5 parts. Satisfactory soft and hard rubber formulations can be made with GR-S reclaim replacing natural rubber reclaim. Neoprene reclaim may be used in conjunction with new neoprene with only slight loss in oil-resisting properties. Buna-N reclaims with little or no added oils are available with excellent oil-resisting properties which should make them valuable for cheap oil-resisting products. Butyl tube scrap can be reused in butyl compounds if contamination of butyl scrap is avoided.

PLASTICS DIGEST

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals directly to publishers.

General

THE EFFECT OF CORONA ON SOLID INSULATING MATERIALS. A. M. Thomas. J. Inst. Elec. Engrs. (London) *91*, II, 549-62 (1944). Films of cellulose acetate and varnished fabric were exposed to discharge in a plane-parallel air gap. The tests were made in air, oxygen and nitrogen. Changes in power-factor permittivity and weight, time until electric puncture and increase in acid content were observed. Direct corona causes deterioration of the dielectrics as a result of the absorption and chemical action of ozone and nitrogen oxides. The ultimate breakdown is attributed to electronic or ionic bombardment of the surfaces.

PLASTICS IN THE SOUTH. R. A. Hardin. Southern Power and Ind. *63*, 8, 86-9 (1945). Because of the availability of raw materials, the production of styrene and methyl methacrylate resins and hydrolyzed-wood-filled-phenolic plastics in the southern states may be an important factor in the plastics industry.

THE X-RAY EXAMINATION OF PLASTICS. W. T. Astbury. Chem. & Ind. *15*, 114-16 (Apr. 14, 1945). The results of x-ray examination of various types of plastic, with particular reference to thermoplastics, are discussed. The implications and applications of such studies are considered.

POLYMERS. IX. DIELECTRIC LOSSES IN NONPOLAR POLYMERS. A. P. Votinov, P. P. Kobeko and G. P. Mikhailov. J. Tech. Phys. (U.S.S.R.) *14*, 18-23 (1944); Chem. Abstracts *39*, 1569 (Apr. 10, 1945). The dielectric losses of styrene, vinylnaphthalene, phenylbutadiene and butadiene polymers are extremely small. The losses are independent of temperature over a wide range up to the softening of the substance where they increase with the increase in temperature. The addition of nonpolar plasticizers does not increase the loss angle. The dielectric losses of materials plasticized with polar plasticizers increase up to a maximum with an increase of temperature; the maximum corresponds to a relaxation in the region of high elasticity. X. DIELECTRIC LOSSES IN POLAR POLYMERS. P. P. Kobeko, G. P. Mikhailov and Z. I. Novikova. Ibid. 24-8. The dielectric losses of vinyl acetate, vinyl chloride, methyl methacrylate, vinylfuran and methyl vinyl ketone polymers are about 100 times higher than those of nonpolar polymers. Mixtures of polar and nonpolar polymers and nonpolar polymers plasticized with polar plasticizers also exhibit higher dielectric losses. As the temperature is increased, two maxima in the loss curve are observed. The upper maximum corresponds to a relaxation in the region of high elasticity. The lower maximum is attributed to voids caused by incomplete packing of the molecules.

NEW APPARATUS FOR DETERMINING THE WATER-VAPOR PERMEABILITY OF SHEET MATERIALS. R. T. K. Cornwell. Paper Trade J. *120*, No. 9, 28-9 (1945). An apparatus for determining the water-vapor permeability of sheet materials is described. The samples are not removed from the cabinet to make the weighings. Arrangements are provided for altering the test conditions. The transmission curve can be determined in a few hours.

LABORATORY CORROSION TESTS. R. M. Burns. Ind. Eng. Chem. Anal. Ed. *17*, 299-302 (May 1945). A critical review of laboratory corrosion tests is presented, with description of methods of measurement, preparation of test specimens, discussion of tests and facilities.

ROSIN ESTER DEVELOPMENT. R. P. Carter. Ind. Eng. Chem. *37*, 448–50 (May 1945). A permanent setup is described for pilot plant development of new products derived through rosin esterification. The reactor capacity for this work ranges from 1 to 400 gallons. The unit process of a rosin esterification can be closely followed at each stage by a method of plotting whereby a straight line represents accurately the progress of the reaction in laboratory, pilot plant and commercial plant operations. The development of a rosin ester to a full-size plant process by these means is achieved in the minimum time and with maximum control.

EFFECT OF TEMPERATURE ON STRENGTH OF LAMINATES. P. Norelli and W. H. Gard. Ind. Eng. Chem. *37*, 580-5 (June 1945). The effect of temperature from -55 to 200°C. on the tensile, compressive and shear characteristics of phenolic laminates are reported. The elevated temperatures were attained by means of a small cylindrical furnace constructed to employ electrical resistance heating. To reach subnormal temperatures, a bath of solid carbon dioxide and alcohol was employed in a cylindrical vessel of annular construction. The yield strength, ultimate strength, modulus of elasticity intension, ultimate strength in compression and ultimate strength in shear are reported at -55, -20, 0, 25, 75, 150 and 200°C. It is concluded from the results that the tensile, compressive and shear strength of phenolic laminates are inversely proportional to temperature, and that the cellulose filled materials are more sensitive to temperature change than their mineral-filled counterparts. The rate of loss of strength as a function of temperature increases above room temperature for the cellulose-filled laminates, whereas it decreases for the mineral-filled materials. Evidence of this variable change is supported by thermal expansion data for a typical laminate. The thermal expansion curve is shown to have a transition point at a temperature well within the range at which the accelerated change in physical properties occurs.

Materials

SEE PROMISE IN PAPREG FOR AIRCRAFT STRUCTURES. R. J. Considine. Aviation *44*, 142–4, 255–61 (Apr. 1945). Paper-base phenolic laminates are combined with plywood to make a high-strength structural material offering possibilities for use in various aircraft applications. The paper-base laminates are used as faces and the plywood is the core. The ultimate tensile strength, tensile yield strength, tensile modulus of elasticity, elongation, modulus of rupture, bearing strength, Rockwell indentation hardness, specific gravity, water absorption, aromatic fuel absorption and fatigue life of various combinations are reported. Wood-strength-properties are greatly increased by bonding paper-base laminates to the outer faces. In this manner wood structures can be designed to carry loads far in excess of the normal wood strength. The strength properties increase as the thickness of the paper-base laminate faces is increased. These materials were investigated for use as aircraft flooring, control surfaces and fuselage sidewall panels.

PROPERTIES AND DEVELOPMENT OF PAPREG — A HIGH-STRENGTH LAMINATED PAPER PLASTIC. E. C. O. Erickson and G. E. Mackin. Trans. A. S. M. E. *67*, 267-77 (May 1945). Papreg, the new paper-base laminate which has recently found application in aircraft and other strength structures, resulted from research at the Forest Products Laboratory. Having more than twice the tensile strength and improved mechanical properties as compared with the best of earlier paper-base laminates, papreg lends itself to low-pressure molding techniques and can be found to moderate double curvature without special

treatment. The development work, the characteristics, properties and service experience with papreg are reviewed.

NYLON POLYAMIDES. H. H. Irvin. Chem. & Met. Eng. *52*, 94-7 (May 1945). The synthesis and properties of the polyamides are reviewed.

THE DIRECT SYNTHESIS OF ORGANOSILICON COMPOUNDS. E. G. Rochow. J. Amer. Chem. Soc. *67*, 963-5 (June 1945). Methods for preparing methyl chlorosilanes, methyl bromosilanes, ethyl chlorosilanes, ethyl bromosilanes, phenyl chlorosilanes and phenyl bromosilanes are described. The preparations which are reported indicate that the reaction of hydrocarbon halides with elementary silicon is a general one, and that it is a useful tool for the synthesis of many organosilicon halides. These in turn are useful intermediates for preparing other organosilicon compounds.

VISCOSITY-MOLECULAR WEIGHT RELATIONS FOR CELLULOSE ACETATE BUTYRATE. J. W. Tamblyn, D. R. Morey and R. H. Wagner. Ind. Eng. Chem. *37*, 573-7 (June 1945). The relations between the molecular weights of fairly homogeneous fractions of cellulose acetate butyrate and the viscosity function ln n_r/c where n_r is the relative viscosity and c is the concentration (determined in acetone and acetic acid) are given for the two cases: a) the limiting value as c approaches O, known as intrinsic viscosity; b) the value at $c=0.25$ gram per 100 cc. The establishment of a relation using the latter viscosity figure permits the determination of the viscosity-average molecular weight without recourse to extrapolation to zero concentration. Upon degrading samples of heterogeneous (unfractionated) cellulose acetate butyrate by heat, ball milling and ultraviolet, it was found that the ln n_r/c values and the number-average molecular weights (from osmotic pressure) are also related by equations similar in form to those obtained on fractions. A means is thus at hand for obtaining the more useful number average of heterogeneous cellulose acetate butyrate from a single viscosity measurement. The establishment of a simple relation between these quantities for any polymer depends on the kinetics of the polymerization or degradation process and its effect on distribution curves.

SPIRAL CONTAINERS OF TRANSPARENT FILMS. Modern Packaging *18*, 88–90 (Mar. 1945). The manufacture and uses of containers made from transparent plastic films by spiral winding.

POLYTHENE — PHYSICAL AND CHEMICAL PROPERTIES. F. C. Hahn, M. L. Macht and D. A. Fletcher. Ind. Eng. Chem. *37*, 526-33 (June 1945). The physical and chemical properties of the hydrocarbon resin — polyethylene — are reviewed. The particular polymer described has a molecular weight between 18,000 and 20,000. This product is tough over a wide temperature range, flexible, translucent and white in color. It has an unusual water resistance, chemical resistance, low power factor, low dielectric constant, high resistivity and high dielectric strength. It is particularly useful for electrical insulation, containers, gaskets, tubing, coatings, filaments and films. As a means of protecting metal surfaces from corrosion and applying polythene coatings in general, the process of flame spraying the powdered material is described. Certain flame-sprayed compositions show good adhesion to metals and give excellent protection against corrosion by water, brine, etc. The various topics discussed include structure, influence of microcrystalline structure on physical properties, mechanical properties, thermal properties, electrical properties, chemical resistance and applications.

Molding and fabricating

PERSPEX BLISTER. Plastics (London) *9*, 223-4 (May 1945). A process for molding a teardrop-shaped fuselage from acrylic resin sheet is described.

Applications

SOME RECENT ADVANCES IN SYNTHETIC ADHESIVES. Plastics (London) *9*, 228-34 (May 1945). Recent developments in synthetic adhesives, gluing techniques and applications are reviewed in this article.

THE FUTURE OF SYNTHETIC RESINS TO THE RUBBER PROCESSOR. D. S. Plumb. Rubber Age *57*, 189-92 (May 1945). The attention of the rubber processing industry is directed toward the possibilities presented by synthetic resins in the production of items heretofore considered as the exclusive domain of rubber. Discussion is from the point of view of the four typical unit operations of calendering, coating and impregnating of textile, laminating and extrusion.

THE KINETICS OF PACKAGE LIFE. C. R. Oswin. J. Soc. Chem. Ind. *64*, 67-70 (Mar. 1945). The rate of change of the moisture content of goods packed in moisture-vapor-resistant wrappings may be expressed without serious error by the equation $T = 69.3\ R\mu/p$ where T is the time in days required for the moisture content of packed materials to change from the initial value to a value which is the mean of the initial value and the equilibrium value. R is the package resistance (the mabs. aqueous vapor pressure gradient required to change the moisture content by 1 percent of the dry weight of the contents in one day), μ is a constant characteristic of the material, and p is the aqueous vapor pressure in mbs. at the storage temperature. Measurements show that this equation incorporates a safety factor of about 10 at 20°C., or 2.5 at 35°C., when R is based on laboratory measurements made at 40°C.

BUILDING LOOKS AT ITS POTENTIALS IN PLASTICS. P. R. Hunter. Pacific Plastics *3*, 15-17 (Feb. 1945). The potential and present applications of plastics to the building industry are discussed. Applications discussed include: resin-bonded plywood, decorative laminates, electrical equipment, toilet seats, window shades, concrete modifiers, wood adhesives, plastic hardware, protective coatings, and insect screen.

Coatings

THE EFFECTIVENESS OF VARIOUS TREATMENTS AND COATINGS FOR CONCRETE IN REDUCING THE PENETRATION OF KEROSENE. F. B. Hornibrook. J. Am. Concrete Inst. *16*, 13-20 (Sept. 1944). Measurements were made of the penetration of kerosene under a 12 ft. pressure head into disks of concrete which had received various treatments or coatings. The materials were classified into seven groups as follows: 1) reference concrete, 2) integral admixtures, 3) sodium silicate and magnesium fluosilicate treatments, 4) plaster coats — plain and with admixtures, 5) magnesium oxychloride type coatings, 6) linseed oil and spar varnish coatings, and 7) synthetic plastic and latex coatings. Comparisons of relative rates of penetration of kerosene are given, together with a discussion of various other properties of each group. The rate of penetration through the organic coatings was low. However, the durability of the linseed oil and spar varnish applications under field conditions for a satisfactory period of time is questionable. The polyvinyl-chloride and alkyl polysulfide coatings were high in material costs.

FORMATION AND AGING OF CORROSION-RESISTANT OIL-CONTAINING COATINGS. A. Y. Drinberg. Trudy Konferensii Korrozii Metal. *2*, 153-8 (1943); Chem. Abstracts *39*, 1995 (May 10, 1945). Linseed-oil base coatings become harder and are more resistant to aging when baked at 400°C. than those baked at 125°C. The degree of oxidation and aging can be determined from the heat of combustion.

EXPERIENCES IN THE UTILIZATION OF COLD-HARDENING LACQUERS. J. Scheiber. Farbe u. Lack *1942*, 123-4; Chem. Abstracts *39*, 1995-6 (May 10, 1945). Resols and resols condensed with urea-formaldehyde resins are used in the formulation of air-drying finishes. The addition of catalysts to the lacquers before use accelerates the cure of the resins. Acid catalysts are not compatible with all pigments. Lacquers based on cellulose derivatives are recommended for acid sensitive surfaces. Resols may be combined in cellulose derivative lacquers to give good coating materials.

U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each.

CLASP PIN. E. G. Marinetti. U.S. 2,373,586, Apr. 10. A safety clasp pin comprising a flat resilient material surrounded by a plastic cover.

CELLULOSE ESTERS. M. E. Martin and T. M. Andrews (to Celanese Corp. of America). U.S. 2,373,630, Apr. 10. Mixed esters of cellulose are prepared by esterifying cellulose in a mixture of two acids, the anhydride of one, and a catalyst, adding the anhydride of the other and additional catalyst when esterification is nearly complete, ripening, and adding solvent for the ester before precipitating.

RESIN. A. J. McGillicuddy, G. A. Kjosness and B. H. Levenson. U.S. 2,373,699, Apr. 17. The resistance to low-temperature cracking of vinyl chloride acetate copolymer is increased by immersing a shaped article in petrolatum at a temperature near the softening point and removing excess oil.

TERPENE RESINS. E. Ott (to Hercules Powder Co.). U.S. 2,373,706, Apr. 17. A solid copolymer is obtained by treating a mixture of a terpene and isobutene in the presence of a catalyst at a temperature between −70 and 200° C.

INDENE POLYMER. F. J. Soday (to United Gas Improvement Co.). U.S. 2,373,714, Apr. 17. Indene is polymerized by heating at 50° C. in the presence of an aryl or alkyl acid sulfate.

LAMINATE. H. N. Atwood. U.S. 2,373,738, Apr. 17. A sheet material comprising laminations of interlocked form retaining strips encased in plastics.

POLYVINYL ETHERS. R. A. Scheiderbauer (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,373,782, Apr. 17. Polyvinyl ethers are prepared by reacting an alkyl halide with an alkali metal alcoholate of a polyvinyl alcohol in liquid ammonia.

CELLULOSE ESTERS. G. W. Seymour, M. E. Martin and R. D. Rowley (to Celanese Corp. of America). U.S. 2,373,786, Apr. 17. Cellulose esters of lower fatty acids are prepared by esterifying in the presence of a catalyst and ripening in several stages in the presence of water and neutralizing agents.

SURGICAL CAST. R. Anderson. U.S. 2,373,802, Apr. 17. A method for preparing a surgical cast from plastic material.

LENS. L. del Riccio. U.S. 2,373,815, Apr. 17. A scanning lens composed of Lucite for creating a visual image of a field of view of 180°.

MOLDING. J. Bailey (to Plax Corp.). U.S. 2,373,939, Apr. 17. An apparatus for preparing plastic material for shaping or molding.

WALLBOARD. G. M. Bruns. U.S. 2,373,945, Apr. 17. A moldable wallboard composition consisting of a mixture of urea-formaldehyde resin, inorganic filler, cotton fiber and water.

REINFORCED MATERIAL. P. Frankfurther. U.S. 2,373,954, Apr. 17. A flexible fibrous material is impregnated with a solution of polyvinyl acetate, the solvent is removed, the composite is heated to the softening point of the plastic and finally subjected to the action of tannic acid or formaldehyde.

DECORATIVE EFFECTS. E. B. Nichols. U.S. 2,374,034, Apr. 17. Thermoplastic articles are decorated by first embedding an inlay impervious to dye and having an opening within the peripheral confines through which the article will be exposed, and then applying the dye.

SAFETY GLASS. J. D. Ryan (to Libbey-Owens-Ford Glass Co.). U.S. 2,374,040, Apr. 17. Laminated safety glass is prepared by sandwiching a thermoplastic sheet between two sheets of glass, placing the assembly in a polyvinyl alcohol container, exhausting air from the container and subjecting the assembly to an autoclave.

SAFETY GLASS. G. F. Watkins (to Libbey-Owens-Ford Glass Co.). U.S. 2,374,056–7, Apr. 17. Laminated safety glass comprising glass sheets and a plastic interlayer which extends beyond the glass to form a flange, and having embedded therein a metal strip to serve as a fastening reinforcement.

RESINS. W. L. Anderson, Jr. (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,374,067, Apr. 17. A polyvinyl acetal resin in which the acetal portion is derived from aldehydes and ketones, is plasticized with cycloaliphatic hydrocarbons obtained by decomposing petroleum sludges.

POLYAMIDES. J. H. Balthis (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,374,069, Apr. 17. Linear polyamides are plasticized by delivering to a mixing chamber a stream of molten polyamide and a stream of plasticizer, forming a mixture and continuously extruding, shaping and cooling the resulting composition.

RESINS. W. J. Burke (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,374,077, Apr. 17. A polymer which is soluble in dilute hydrochloric acid and which yields hard films is prepared by reacting a N, N'–bis (alkoxymethyl) urea with an alkylolamine.

VINYL POLYMERS. D. D. Coffman (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,374,078, Apr. 17. A copolymer of divinyl formal and vinyl acetate.

ALLYL ESTER POLYMERS. R. T. Dean (to American Cyanamid Co.). U.S. 2,374,081, Apr. 17. A copolymer of an ester of a saturated aliphatic monocarboxylic acid and an allyl alcohol.

FABRIC. J. R. Myles, D. Whittaker and F. J. Siddle (to Imperial Chemical Industries Ltd.). U.S. 2,374,121, Apr. 17. A tautened fabric is obtained by stretching the material on a frame and impregnating and coating with the solution of chlorinated polyethylene.

RESIN. F. T. Peters (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,374,126, Apr. 17. A rigid gel which is comprised of a synthetic linear polyamide and a solvent consisting of a mixture of an alcohol and an aromatic hydrocarbon or a chlorinated hydrocarbon.

POLYAMIDES. L. F. Salisbury (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,374,137, Apr. 17. An improved polyamide composition is prepared by heating, under anhydrous conditions, a mixture of different polyamides at amide-forming temperatures until an insoluble material having a higher melting point than those of its component members is obtained.

POLYAMIDES. G. B. Taylor (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,374,145, Apr. 17. A polyamide comprising the reaction product of an aromatic acid, phenol or aryloxyalkyl amine with a mixture of diamine and dibasic carboxylic acids, or a monoaminomonocarboxylic acid.

POLYMERS. F. J. Soday (to United Gas Improvement Co.). U.S. 2,374,242,

Apr. 24. A process for polymerizing an olefin-containing light oil piperylene fraction which consists in adding boron trifluoride at a temperature of −10° C.

CONDENSATE. O. Albrecht, C. Graenacher and R. Sallmann (to Society of Chemical Industry). U.S. 2,374,259, Apr. 24. The product of reacting an N-methylol carboxylic acid monoamide, esters of N-methylol carboxylic acids with alpha-chloro-substituted carboxylic acids and N-halogenomethyl-substituted amides.

SHEET FORMING. J. H. Rooney, R. S. Locke and P. R. Hawtin (to British Celanese Ltd.). U.S. 2,374,308, Apr. 24. Thick sheets of a thermoplastic cellulosic compound are prepared by depositing a solution on a smooth rigid surface, evaporating the solvent, stripping off the sheet, coating the surface with a material to prevent adhesion, laying the sheet on the surface, building up the desired sheet by adding more solution and finally stripping the sheet and evaporating the residual solvent.

OIL SOLUBLE RESINS. L. R. Whiting (to Bakelite Corp.). U.S. 2,374,316, Apr. 24. A thermoplastic, oil-soluble resin consisting of a monomeric styrene reacted with a phenol-aldehyde resin.

BUOYANT MATERIAL. W. H. Moss (to British Celanese Ltd.). U.S. 2,374,372, Apr. 24. A buoyant material comprising an assembly of closed cylinders full of air formed of a textile fabric coated with a synthetic polymer.

CELLULOSE ESTERS. B. T. Lamborn (to Hercules Powder Co.). U.S. 2,374,547, Apr. 24. In the manufacture of cellulose esters the product is precipitated from the acylation dope by adding an aqueous solution of a lower fatty acid salt of a colorless cation.

POLYAMIDES. M. M. Brubaker (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,374,576, Apr. 24. A composition consisting of a linear polyamide and a phenol-containing hydroxy phenyl nucleus.

ALKYD RESINS. H. W. Gray (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,374,598, Apr. 24. The resinous reaction product of hydroxyacetic acid, a polyhydric alcohol, a polybasic carboxylic acid, linseed oil or linseed oil acid.

COATING. S. M. Kolar and A. G. Sternberg (to Allied Finishing Specialties Co.). U.S. 2,374,603, Apr. 24. A coating for plastic materials comprising a nitrocellulose film base, a solvent medium including mesityl oxide, a solvent for softening the surface of plastic and a plasticizer for both the coating and the plastic.

RESIN. C. J. Brown (to Imperial Chemical Industries, Ltd.). U.S. 2,374,646, May 1. A resinous product having a structure characterized by anhydrophosphinic acid anil groups having double bond linkages between phosphorous atoms direct to aryl groups.

CONDENSATE. W. J. Burke and F. W. Hoover (to E. I. du Pont de Nemours and Co., Inc. U.S. 2,374,647, May 1. The condensation product of a glycol or dithiol with a heteromonocyclic urea derivative.

CONDENSATE. W. J. Burke and J. H. Werntz (to E. I. du Pont de Nemours and Co., Inc. U.S. 2,374,648, May 1. Water soluble condensates are prepared by reacting at 50 to 250° an *N,N'*-bis (alkoxymethyl) urea with a glycol and a monosulfonamide of a straight chain hydrocarbon of from thirteen to twenty carbon atoms.

RESIN. J. P. Bain (to Nelio Resin Processing Corp.). U.S. 2,374,657, May 1. A resin is prepared by condensing formaldehyde and abietic acid, esterifying the alcohol formed thereby with a volatile carboxylic acid, and finally heating the ester to distill off the acid.

PROTEIN. C. Dangelmajer. U.S. 2,374,667, May 1. Proteins such as casein or soybean protein are plasticized with glycerol or formamide and diethanol amino triethanol amine, glycerol monoglycolate, triethylene glycol ethanol acetamide and ethanol formamide.

SOYBEAN OIL PLASTICS. E. Miller. U.S. 2,374,692, May 1. A material suitable for the manufacture of golf ball covers is obtained by oxidizing soybean oil at elevated temperatures until gelled and mixing with a rubbery gum.

SHEET MATERIAL. T. R. Latour (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,374,759, May 1. Sheet wrapping material comprising rubber hydrochloride which has been plasticized with dibutyl sebacate.

BITUMEN EMULSION. E. E. Mayfield (to Hercules Powder Co.). U.S. 2,374,766, May 1. A stable emulsion of asphalt comprising asphalt, water, a saponified resin as a stabilizer, and methyl cellulose as a dehydration and viscosity controlling agent.

FILM. J. A. Mitchell and D. D. Lanning (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,374,767, May 1. An oil and grease resisting heat sealable pellicle comprising a base film of regenerated cellulose coated with a solution of polyvinyl acetate, nitrocellulose, and di (ethyleneglycol monomethyl ether) phthalate.

VINYL ESTER. R. P. Roberts, E. B. Johnson and M. A. Young (to Celanese Corp. of America). U.S. 2,374,780, May 1. A solution for use in producing textiles, films and shaped articles by extrusion, comprising a polymerized mixture of vinyl chloride, vinyl acetate, acetone and ethylene methylene ether.

MODIFIED UREA RESIN. S. S. Gutkin (to Falk and Co.). U.S. 2,374,811-2, May 1. A modified urea-aldehyde resin is prepared by forming an opaque resinous reaction product of urea and an aldehyde, mixing with a polyhydric alcohol and a polybasic carboxylic acid, heating sufficiently to drive off water and fuse the acid, and finally raising the temperature and adding an aromatic monocarboxylic acid or a mixture of such acids or an acylic monocarboxylic acid or a mixture of such acids.

MODIFIED PHENOLIC RESIN. S. S. Gutkin (to Falk and Co.). U.S. 2,374,813-4, May 1. A modified phenol-aldehyde resin is prepared by forming an initial phenol-aldehyde condensate of the infusible type by refluxing the aldehyde with a phenol in the presence of an alkaline catalyst, forming a homogeneous mass of the condensate and an unmodified polyhydric alcohol and reacting the mass with a polybasic carboxylic acid by heating to a temperature sufficient to drive off water and fuse the carboxylic acid, and finally adding an acyclic monocarboxylic acid or an aromatic monocarboxylic acid or, in some cases, mixtures of such acids.

FLOORING. J. W. Kemmler and E. R. Erb, Jr. (to Sloane-Blabon). U.S. 2,374,940, May 1. A floor covering comprising a backing having decorative material applied thereto and a semi-transparent sheet composed of irregularly pigmented resinous material which is applied thereto.

RESIN. F. Vass (to Krebs and Co.). U.S. 2,374,963, May 1. A synthetic product is prepared by intermixing a water soluble inorganic polysulfide, a dihalogenated aliphatic hydrocarbon, a carbonylic compound and an organic derivative of ammonia such as urea in the presence of a phenol catalyst and heating to initiate the reaction.

COMPOSITION. R. W. Lawrence (to Hercules Powder Co.). U.S. 2,375,008, May 1. A low density free-flowing particulate material of high compressive strength comprising cellular carbonaceous particles such as cork, corncobs, balsa, etc., bonded with a thermosetting synthetic resin.

PROTEIN PLASTIC. S. A. Harrison (to B. F. Goodrich Co.). U.S. 2,375,103, May 1. A composition comprising a prolamine which has been hardened by means of an amido material.

COLLAPSIBLE CORE. C. H. Terry. U.S. 2,375,148, May 1. A collapsible core adapted to be disposed within a mold and comprising a flexible envelope having movable side walls.

BOOKS AND BOOKLETS

Write directly to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent post-paid at the publishers' advertised prices.

Plastics

by J. H. DuBois

Published by the American Technical Society, 858 E. 58th St., Chicago 37, Illinois, 1945

Price, $4.00 **447 pages**

This, the third edition of "Plastics," has only recently been published. The original edition contained basic and universal knowledge concerning the history and origin of plastics, and raw material sources. It included information on the chemical and electrical properties, and the limitations of the various plastic materials. The text also covered facts on fabrication and design.

In order to bring this book abreast of the times, the author has added information on new trade names and identification procedure and material on contact resins, postforming, expanded plastics, vacuum forming and the blowing process. In addition Mr. DuBois has included information on the following new materials: polyethylene, silicone, furane resins, glass melamine laminates and high temperature thermoplastics. Additional sections deal with improved insert materials, insert salvage, the crazing of polystrene.

F. B. S.

Protective and Decorative Coatings

Prepared by a staff of specialists under the editorship of Joseph J. Mattiello, Ph.D., consultant, Plastics Research and Development Branch, Military Planning Division

Published by U. S. Government Printing Office, 1945

Price, $1.25 **349 pages**

The term "coatings" in this book, a compilation of lectures delivered to personnel of the Army, Navy and various Government Agencies, covers varnishes, lacquers, textile coatings, plastics and similar materials whose function may be "singly or collectively protective, decorative or of a technical nature."

Specific formulations were avoided in these lectures which dwell, instead, upon basic principles and technical information. Although emphasis is placed upon the newer developments (in synthetic oils, synthetic resins, solvents and thinners, driers, pigments and plastics) which have direct application to the war effort, considerable discussion is directed to subjects of general interest—notably color and color applications, fluorescent materials, and a comprehensive study of wood and its relation to coatings. Additional food for thought is provided for the general reader in the question-and-answer forums appearing at intervals throughout the book.

Prepared by specialists in various branches of the coating industry, the lectures are clearly written and illustrated. The book should not be confused with the series (bearing the same title) published by John Wiley and Sons, Incorporated.

★ A MONOGRAPH ENTITLED "Wartime Technological Developments," which is a study made for the subcommittee on war mobilization of the Committee on Military Affairs, United States Senate, has been received from the U. S. Dept. of Labor. The book is said to be the first effort to compile and digest information already released on hundreds of scientific achievements, and is suggested as a useful survey for Congress and for public and private agencies or persons engaged in formulating postwar programs. Part I presents a brief appraisal of the published literature on wartime technological developments, whereas Part II digests some of the more significant excerpts from the literature for 1942 and 1943. A digest for 1944 is in preparation and will be issued as a supplement to this survey. The monograph may be obtained for fifty cents through the Supt. of Documents, U. S. Government Printing Office, Washington, D. C.

★ "A SHORT HISTORY OF THE Arlington Company," a publication of E. I. du Pont de Nemours and Co., Inc., Wilmington, Del., gives an interesting account of the organization which later became the nucleus of the present du Pont Plastics Department. The story traces developments in the pyroxylin plastics industry from the early years, and is interspersed with anecdotes and mention of personalities in the field.

★ RECEIVED FROM CELANESE Plastics Corp., New York, N. Y., is a portfolio of advertisements of the Lumarith thermoplastics which have appeared over a period of the last three years. The collection could be considered a panorama of the molders' art during the war years.

★ THE INDEX TO A. S. T. M. STANDARDS, published as of December 1944, has recently been released. An adjunct to the Book of A.S.T.M. Standards, the index is a ready reference for locating any standard in the bound publication of the Society in which it appears. It may also be used for ascertaining whether a standard on a specific subject has been issued by the Society. Contained in the volume are a subject index, numerical index and lists of standards, tentative standards and emergency standards.

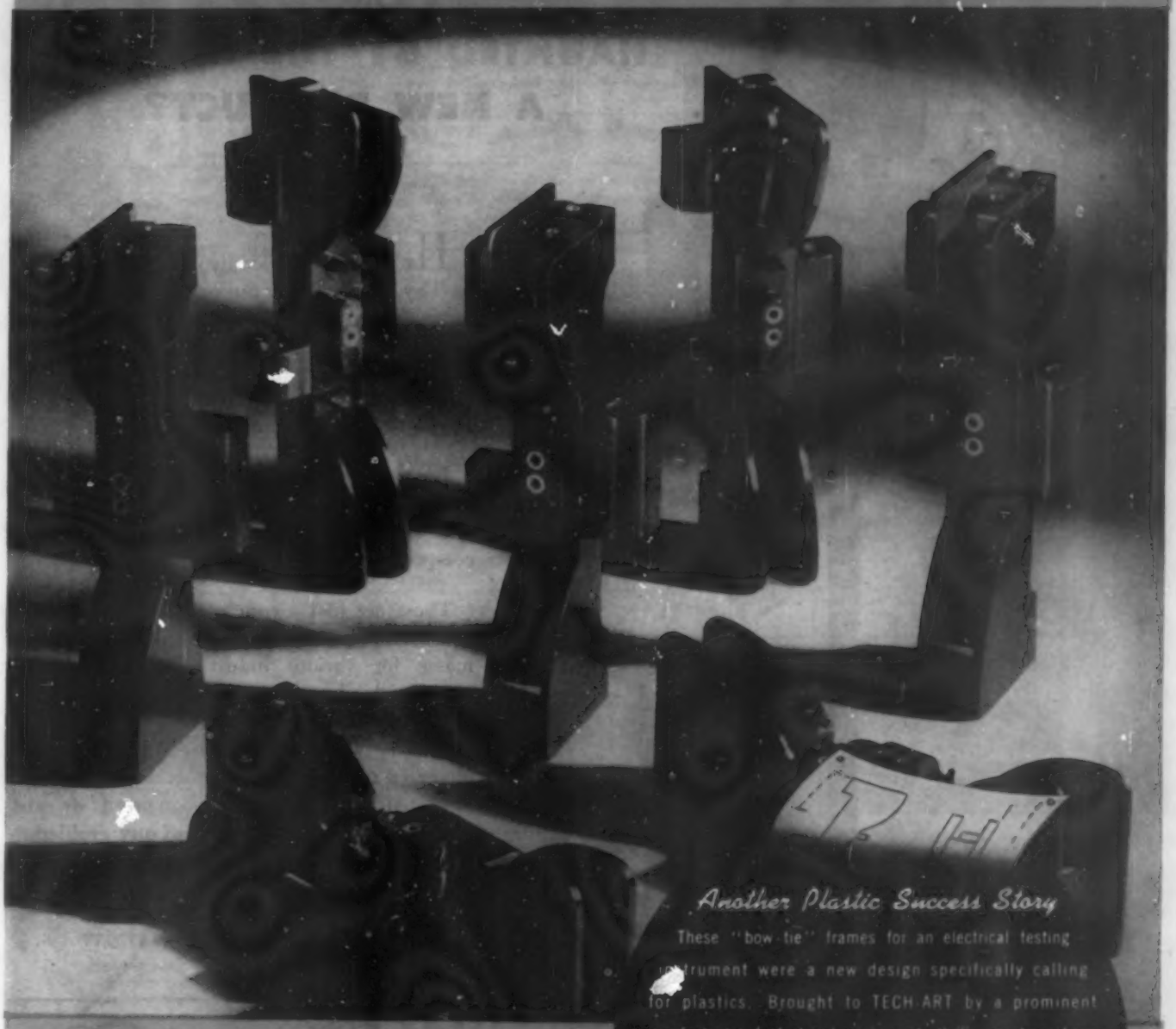
★ BULLETIN NO. 762, ENTITLED, "Wool Dyeing: Effect of Variations in Wool," has been received from Calco Chemical Div., American Cyanamid Co. Bound Brook, N. J. This is actually a paper which was presented at the annual meeting of A.A.T.C.C. on Oct. 14, 1944, and is a technical treatment of the subject. Factors found to affect the rate of absorption of acid dyes by wool include, among others, natural weathering, light exposure, the presence of oils or grease, boiling water treatment and resin treatment. Twenty-four graphs and fourteen half-tones supplement the text.

★ TECHNICAL DATA ON BAKElite cast resins have been compiled in a bulletin published by Bakelite Corp., New York 17, N. Y. The booklet deals with the general characteristics of Bakelite cast resins, the process of casting, and the various forms and shapes in which the resins can be formed. General-purpose and special purpose cast resins are discussed, followed by tables of physical, electrical and chemical properties. Uses are listed and possible methods of machining and finishing are fully discussed.

★ RECEIVED FROM IVANO, INC., Malden, Mass., is an intriguing non-technical little booklet called "Fish Silver — Mermaid to Manmade," which tells the story of crystalline guanine, its salts and various derivatives. Suggested applications of the decorative lacquers in which these materials are used as coatings for pearl beads and novelties are included. Guanine is also used in coatings applicable to display and commercial art work, in inks and in the manufacture of paper.

★ A NEW TABER ABRASER TESTing handbook has just been released by Taber Instrument Corp., North Tonawanda, N. Y. The manner in which the abraser performs is explained and a typical test is followed through, step by step. The versatility of the abraser is brought out in a listing of the many materials that can be tested for abrasion resistance with this unit. These materials include paints, lacquers and plastic coatings; rubber and synthetic products; and textiles.

An Electrical Idea . . . Molded in PLASTICS



Another Plastic Success Story

These "bow-tie" frames for an electrical testing instrument were a new design specifically calling for plastics. Brought to TECH-ART by a prominent manufacturer of electrical equipment, they were turned over to TECH-ART engineers, who designed a mold and selected a material that would produce parts with a dimensional variation of less than .005-inch. TECH-ART mold-building craftsmen added the finishing touch—producing the precision mold that made these accurate parts another Plastic Success Story by TECH-ART.

Whether a product is required to withstand the charring heat of an electrical spark or the corrosive bite of an acid bath, two extra features set it off when it's a TECH-ART molded product. The first is sound product engineering—the second is master craftsmanship in mold-building. The two combined start off TECH-ART's wide molding facilities with the trouble-free molds necessary to insure that your product—mechanically, physically, and dimensionally—will be another plastic success story by the time it reaches the job for which it is custom-built.

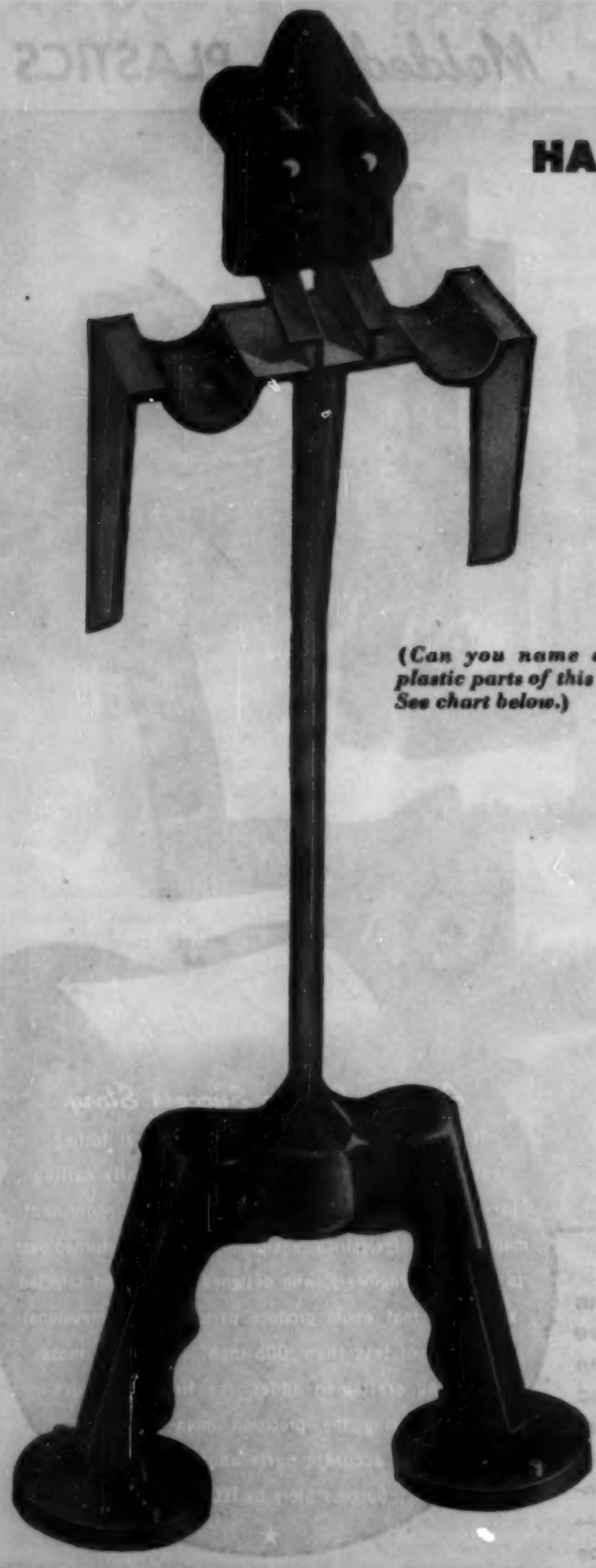
TECHNICAL NOTES: Produced by compression, these parts were molded from a material which provided the high dielectric properties necessary for trouble-free service in an electrical circuit.

TECH-ART PLASTICS COMPANY

36th Ave. and 41st Street • LONG ISLAND CITY, N. Y. • Tel. AStoria 8-6050-1

SUCCESSORS TO BOONTON RUBBER MANUFACTURING COMPANY

PIONEER PLASTIC MOLDERS . . . Established 1891



HAUNTED BY THE NEED OF A NEW PRODUCT?

(Can you name all the plastic parts of this spook? See chart below.)

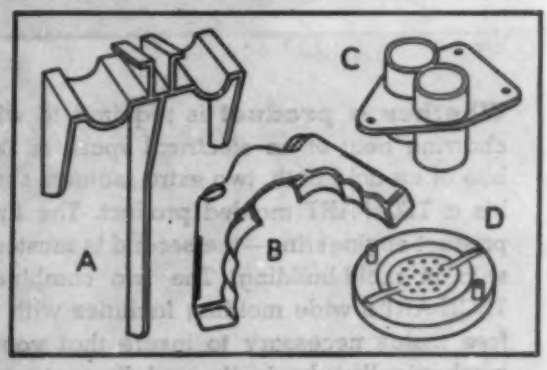
He's really a friendly spook and means well by you and your business.

Take a close look at him and you'll see how he materialized—out of a number of unusual and useful plastic products made by the Plastics Division of Continental at Cambridge, Ohio.

For instance, his rakish body is an acid baffle made of polystyrene by injection, while his head is a fairing made of rag-filled phenolic by compression.

Those are just a couple of the hundreds of practical plastic products now turned out en masse for various industrial applications—along with plane parts, combs and cogs, impellers and insulators—all of them the result of combining years of experience with the vastly increased resources and production facilities of Continental. Such a combination means we can promise you a rapid solution of any problems you have over improving old products and bringing out new ones.

Tune in: "REPORT TO THE NATION" every week over CBS coast-to-coast network.



(A) Acid baffle—injection; (B) gun handle—compression; (C) fairing—compression; (D) throat for loudspeaker—compression.

CONTINENTAL CAN COMPANY, INC.

PLASTICS DIVISION

HEADQUARTERS: Cambridge, Ohio

Sales Representatives in all Principal Cities

COMPRESSION • INJECTION • EXTRUSION
SHEET FORMING • LAMINATION

Other Continental Products: Metal Containers • Fibre Drums • Paper Containers • Paper Cups • Plastic Products • Crown Caps and Cork Products • Machinery and Equipment.

	FEATURES	Airtronics	Preheater "A"	Preheater "B"	Preheater "C"
1	**DUAL LOAD SELECTION** — two independent sets of timer and power controls.	✓			
2	**AUTOMATIC POWER REGULATION** — constant power is maintained during heating interval.	✓	✓		
3	**AUTOMATIC LOAD CIRCUIT TUNING** — preheater efficiency is maintained at maximum regardless of changes in material characteristics.	✓			
4	**INPUT VOLTAGE REGULATION** — compensates for variations in line voltage over 200-240 volt range.	✓	✓		✓
5	**DESIGNED FOR *CONTINUOUS* OPERATION** — tubes, transformers and all other components operate at conservative ratings for *continuous* service, insuring minimum operational failures.	✓			
6	**STEPLESS POWER CONTROL** — permits easy, accurate pre-setting of power output at desired level.	✓	✓		
7	**CONTROLS CONVENIENTLY PLACED** — timer and power controls accessible to operator if minor adjustments are needed.	✓	✓		
8	**SELF-ALIGNING OUTPUT ELECTRODES** — insure equal distribution of electro static field and heating.	✓			✓
9	**ADJUSTABLE AIR GAP** — provides either contact or air gap between upper electrode and preforms.	✓			
10	**WIDE RANGE OF APPLICATION** — special electrodes available for preforms of unusual shape.	✓		✓	
11	**PREFORMS IN FULL VIEW** — preforms are visible at all times to the operator.	✓	✓	✓	
12	**UPPER ELECTRODE INTERGRATED WITH HOOD SHIELD** — when shield is raised, upper electrode rises and retracts; when shield is lowered, upper electrode descends to operating position.	✓	✓		

Compare AIRTRONICS Model DE with the field

Make this 12-point comparison test yourself — consider the facts . . . then install AIRTRONICS

THE *Only* PREHEATER THAT HAS *all* THESE ADVANTAGES

AIRTRONICS

MODEL DE

All of these advantages add up to *Faster, Better, Simpler* preheating. Consult the AIRTRONICS Sales engineer nearest your plant for the engineering details and how you can use AIRTRONICS to speed your production schedule, or send for the *new* folder that completely describes this high-production preheater. Write Dept. MP.

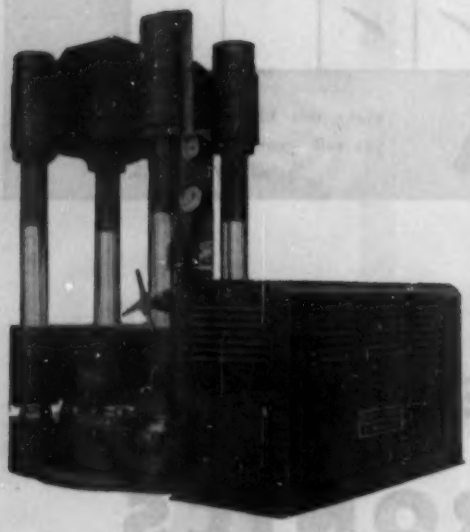
Airtronics MFG. CO.

CHICAGO, 407 S. Dearborn Zone 5 — NEW YORK, 31-28 Queens Blvd. Long Island City, Zone 1 — LOS ANGELES, 5245 W. San Fernando Rd. Zone 26

Look for this TRADE MARK

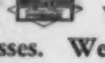
BIRDSBORO HYDRAULIC

. . . It's Your Key to Greater Press Value



Because purchasing a hydraulic press is a major investment for even a large company, the trade mark is a vital key in making sure the investment is a sound one.

At Birdsboro, we like to think of the trade mark as symbolic of trained engineers constantly at work improving the designs of Birdsboro high speed presses to make them produce more parts per hour . . . to make them safer, easier to use . . . to make them cost less to maintain. Thousands of satisfied users in the modern plastics and allied industries testify to our success in providing greater press value per dollar invested.

So look for this  when you're in the market for hydraulic presses. We'll be glad to put our experience to work on your next hydraulic press problem.

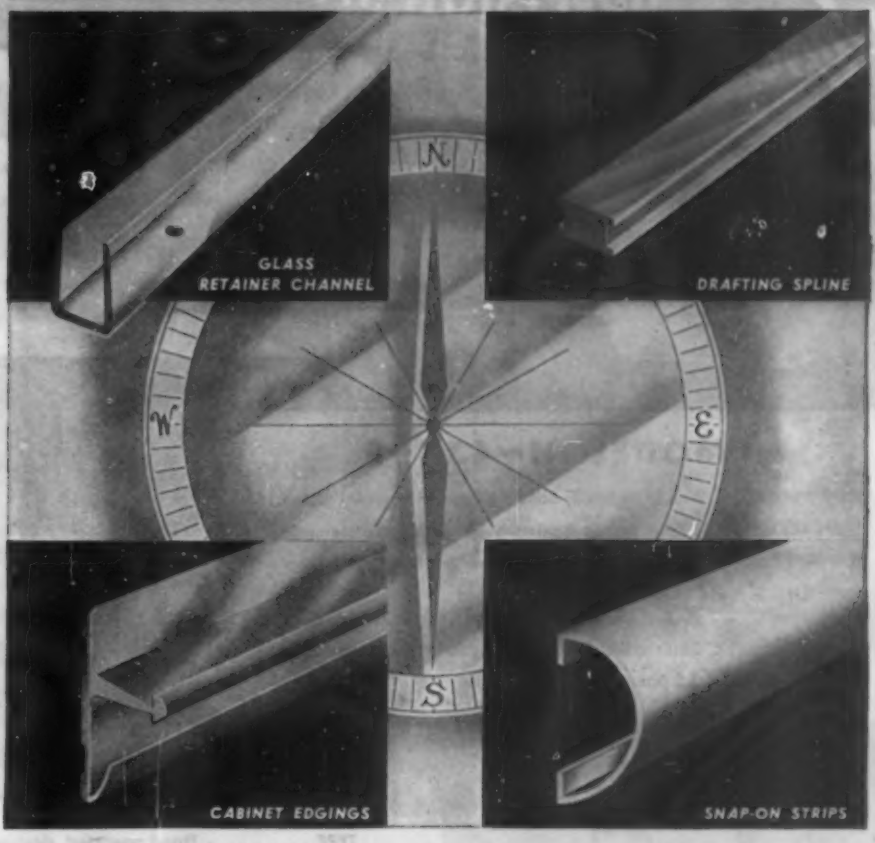
BUY WAR BONDS

BIRDSBORO STEEL FOUNDRY AND MACHINE COMPANY • BIRDSBORO, PA.

BIRDSBORO

HYDRAULIC PLASTIC PRESSES

EXTRUDED IRREGULAR SHAPES



TRUE ★ ACCURATE ★ UNIFORM

When Yardley Makes Them

Guiding you in selecting the right plastic material . . . pointing out the best technique is only half our job.

The other half is making your product with the precision you have a right to expect . . . not once, but all the time.

If you have a plastic problem involving good extruded irregular shapes, Yardley knows how to get to the solution.

YARDLEY *Plastics Co.*

142 PARSONS AVE. COLUMBUS 15, OHIO

Extruders of SARAN, CELLULOSE ACETATE, BUTYRATE, POLYSTYRENE, STYRALLOY and VINYLS. Also Injection and Compression Molding.

Pesco PRECISION HYDRAULIC HAND PUMPS

MODEL 1H–622–D

TYPE . . . . . Conforms to spec. AN-P-14 and drawing AN 6201-1.
DISPLACEMENT . 1.5 cubic inches maximum per complete cycle.
CAPACITY . . . . 0.19 g.p.m. at 30 cycles per min. at 1500 p.s.i.
OPERATING PRESSURE . . . 1500 p.s.i. with a handle torque of 1100 in. lbs.
HANDLE . . . . . Usually not supplied with this unit.
WEIGHT . . . . . 2.4 pounds without handle.

MODEL 1H–437–F

TYPE . . . . . Hand operated, double acting differential piston.
DISPLACEMENT . 1.6 cu. inches maximum per each complete cycle.
CAPACITY . . . . 0.20 g.p.m. at 30 cycles per min. at 1000 p.s.i.
OPERATING PRESSURE . . . 1000 p.s.i. with 50-lb. force exerted on handle.
HANDLE . . . . . Detachable, 18⅞ in. long, 50° total movement.
WEIGHT . . . . . 2.5 pounds with handle.

MODEL 1H–437–K

TYPE . . . . . Hand operated, double acting differential piston.
DISPLACEMENT . 1.6 cu. inches maximum per each complete cycle.
CAPACITY . . . . 0.20 g.p.m. at 30 cycles per min. at 1000 p.s.i.
OPERATING PRESSURE . . . 1000 p.s.i. with 50-lb. force exerted on handle.
HANDLE . . . . . Detachable, 18⅞ in. long, 50° total movement
WEIGHT . . . . . 2.76 pounds with handle.

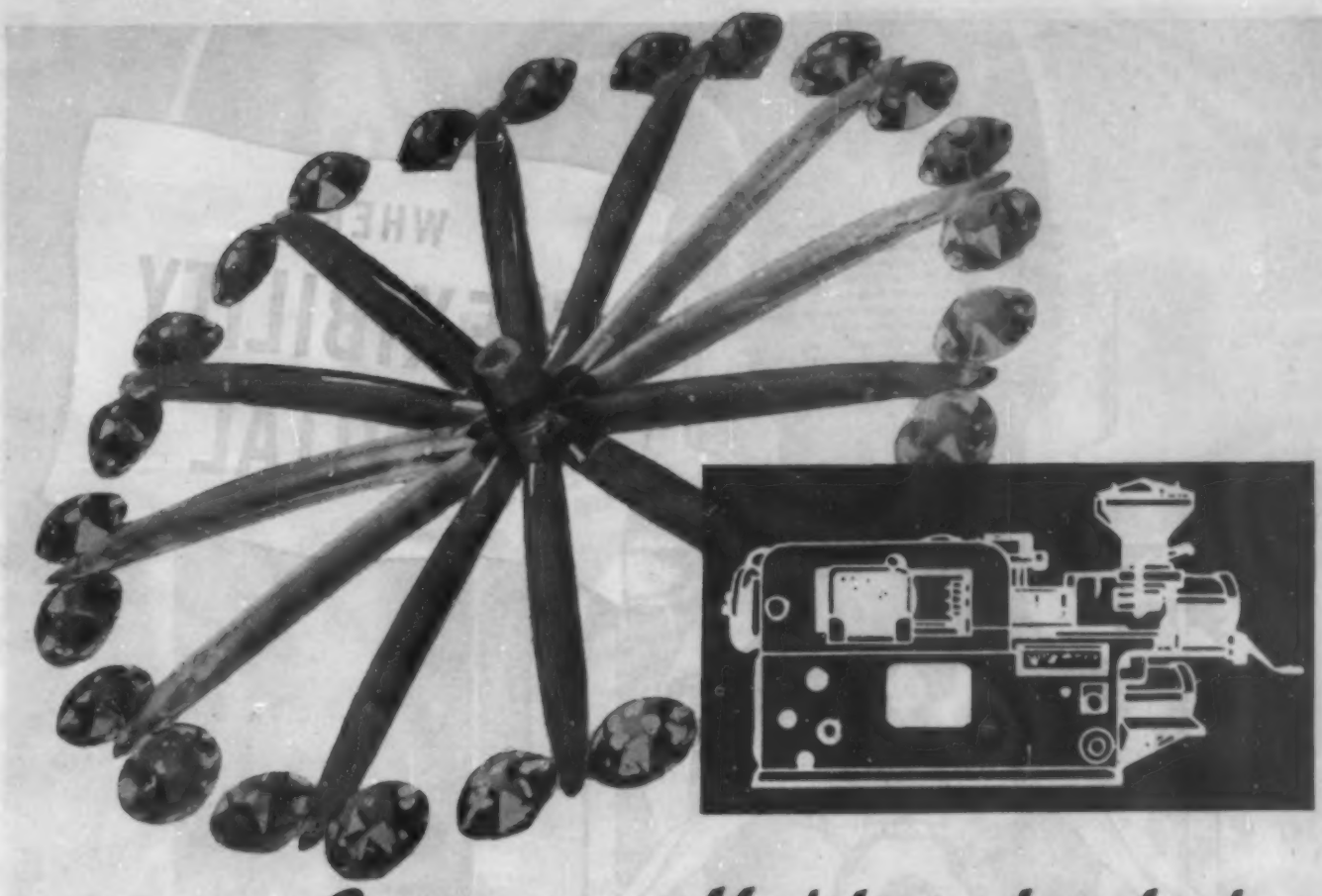
● Featuring new standards of volumetric and mechanical efficiency, PESCO Hydraulic Hand Pumps will do a better job wherever small quantities of fluid are to be pumped at high pressure. Unusually compact and lightweight, these precision pumps are self-lubricating . . . built with spring-laden ball check valves for uni-direction fluid flow, and needle bearings to minimize operating torque.

In addition to these pumps, PESCO design and manufacturing skill extends through a complete line of air, fuel and hydraulic pumps . . . precision equipment that opens the way for more efficient use of Pressurized Power and controlled liquid flow. Descriptive literature available. Write, specifying the equipment in which you are interested. PESCO Products Co., (division Borg-Warner) 11610 Euclid Avenue, Cleveland 6, Ohio.

Division Borg-Warner

In Precision Hydraulics, Fuel Pumps, Air Pumps, Related Accessories . . .

PERFORMANCE POINTS TO Pesco FIRST



Injection Molders find that

HARD CHROMIUM PLATING *pays!*

This extra care provides extra wear—requires less molding pressure—increases die life—insures longer runs.

A thin shell of hard chromium skilfully applied to the mold cavity, gate, runner, sprue bushing, injection cylinder or nozzle bore will prevent corrosion, reduce friction, alleviate sticking, maintain the luster and perfection of the cavity surfaces and preserve intricate design details.

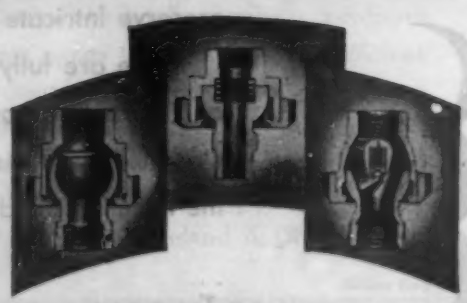
We are fully equipped to hard chromium plate the most complicated molds and parts. That our process and technique *add little in cost but much in value* is evidenced by the steady increase in demand for hard chromium plating throughout the injection molding field. Inquiries invited!

INDUSTRIAL HARD CHROMIUM CO.

"Armorplate for Industry"

15 ROME STREET, NEWARK 5, N. J.

Feed lines which carry the essential fluids of industry need constant protection against those "traffic interrupters"—vibration and shock. Barco Flexible Joints provide such protection by compensating for contraction and expansion with responsive movement in every direction. For over 30 years they have been the accepted standard in every field of both industry and transportation. Barco Manufacturing Co., Not Inc., 1809 Winnemac Ave., Chicago 40, Illinois.



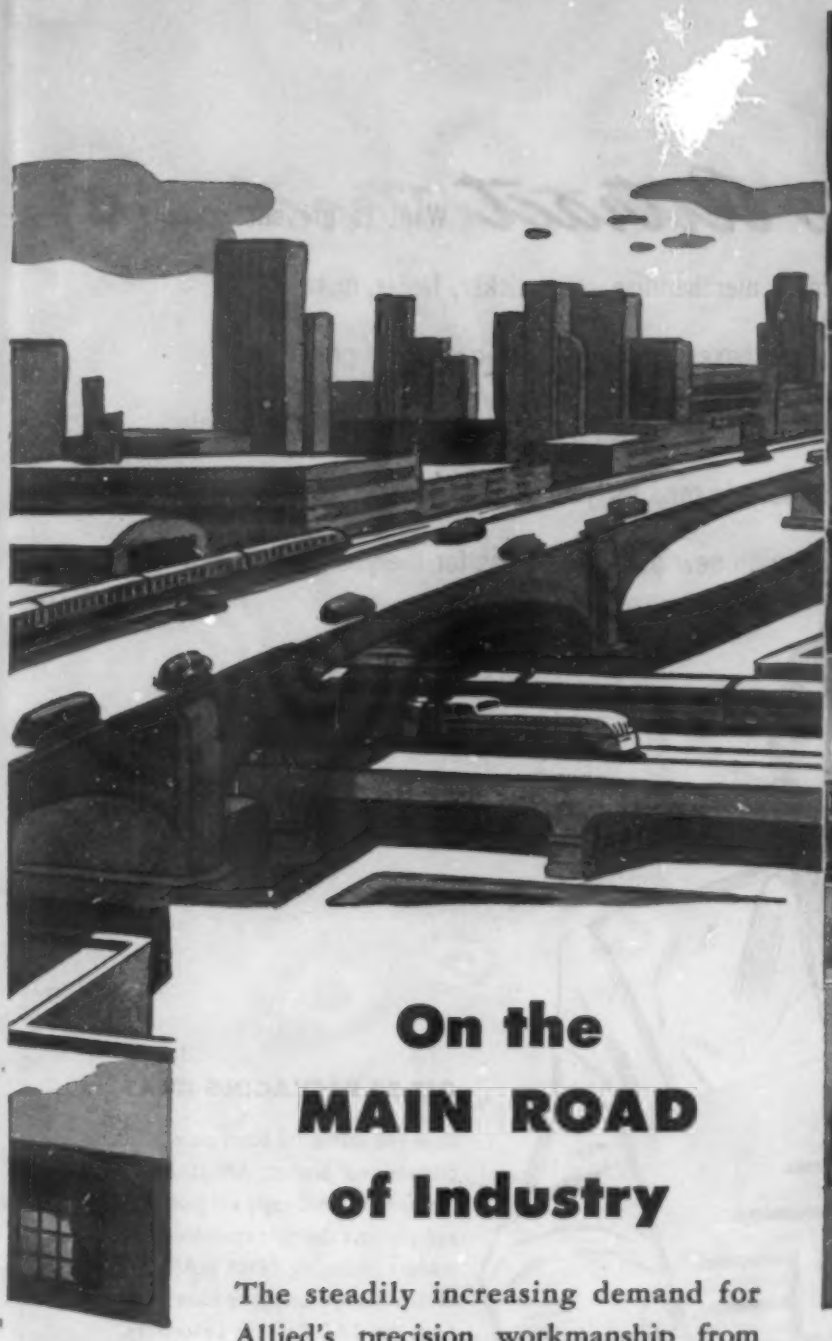
In Canada: The Holden Co., Ltd., Montreal, Canada

BARCO FLEXIBLE JOINTS

FREE ENTERPRISE—THE CORNERSTONE OF AMERICAN PROSPERITY

Not just a swivel joint . . . but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

"MOVE IN EVERY DIRECTION"



On the MAIN ROAD of Industry

The steadily increasing demand for Allied's precision workmanship from the very beginning has fostered the enlargement of its working area from 5000 square feet in one plant in 1915, to 275,000 square feet in four great plants today. This growth over a period of 30 years . . . steady and consistent . . . places Allied solidly on the main road of industry . . . establishes Allied as a standard source of precision tools and parts *in great quantity* for automotive, radio, home appliance, plastics, aviation, furniture, electrical, farm implement and many other mass production manufacturers. Send in *your* blueprints . . . or write to Allied, now.

BUY WAR BONDS

★ ★ ★

"IT'S AN ALLIED PRODUCT." In its four plants shown above—two in Detroit and two in Hillsdale, Michigan—Allied makes special cold forged parts, cap screws, etc.; hardened and precision ground parts; sheet metal dies (from the largest to the smallest); R-B Interchangeable Punches and Dies; jigs, fixtures, steam-heated plastic molds and special production tools.

ALLIED PRODUCTS CORPORATION

Department 26
4622 Lawton Avenue
Detroit 8, Michigan

Pack to Attract

Want to prevent losses on goods in transit? Want to sell more merchandise . . . quicker, faster, more economically? Then make your corrugated boxes work for you two ways . . . protect and promote. For modern package designs and skillful package engineering . . . for corrugated packages that are "salespaks"—be sure to send for your copy of H & D's new book, "Pack to Attract." It's filled to overflowing with new packaging ideas for the post-war period.

GET 23 PACKAGING IDEAS

Make your corrugated boxes protect and promote your product. Add color and display appeal to strength and protection and you have the right combination for modern packaging. "Pack to Attract" contains 23 new packaging ideas direct from the H & D Package Laboratory. Send for your copy today.

Hinde & Dauch

AUTHORITY ON PACKAGING

THE HINDE & DAUCH PAPER COMPANY, 4538 DECATUR STREET, SANDUSKY, OHIO

Factories in BALTIMORE • BOSTON • BUFFALO • CHICAGO • CLEVELAND • DETROIT • GLOUCESTER, N. J. HOBOKEN • KANSAS CITY • LENOIR, N. C. • MONTREAL • RICHMOND • ST. LOUIS • SANDUSKY, OHIO • TORONTO

When the green light for peace time production is given, be sure you understand the complete story of plastics and how it applies to your problems. No matter what your requirements in precision plastics may be — feel free to call upon us —
For your tough plastics problems
IN COMPRESSION, INJECTION, TRANSFER MOLDING and PRECISION MACHINING
ARNOLD
Brilhart
LTD.
435 MIDDLENECK RD. GREAT NECK, N.Y. Phone: GREAT NECK 4054

Hanna Cylinder Calculator

What the Hanna Calculator will do—

WHEN YOU HAVE:	YOU CAN FIND:
Required force and line pressure	• Effective area
Required force and effective area	• Line pressure
Effective area and line pressure	• Force
Effective area and cylinder stroke	• Cylinder displacement
Cylinder displacement and cylinder stroke	• Effective area
Effective area and cylinder displacement	• Cylinder stroke
Cylinder displacement and time	• Pump delivery
Pump delivery and time	• Cylinder displacement
Cylinder displacement and pump delivery	• Time
Pump delivery and pipe velocity	• Pipe size
Pump delivery and pipe size	• Pipe velocity
Pipe size and pipe velocity	• Pump delivery
Effective area and pump delivery	• Stroke velocity
Pump delivery and stroke velocity	• Effective area
Effective area and stroke velocity	• Pump delivery
Pump delivery—Pump efficiency and pressure	• Horse power
Pump delivery Pump efficiency and horse power	• Pressure
Pressure—Horse power and pump efficiency	• Pump delivery
Pressure—Horse power and pump delivery	• Pump efficiency

A time-saver...

for accurate answers . . . quickly computes size pressure, speed of cylinders . . . size of pump, valves, pipe and motor

What cylinder force and velocity is needed? How much must the pump deliver? What h.p. should the motor be? Size of pipe and valves?

These are some of the problems you can work quickly and accurately with the Hanna Calculator Designed for busy engineers who are using more and more smooth hydraulic cylinder power, this new tool eliminates the need for multiple tables, graphs, chartsand data. Nineteen distinct operations may be performed on the calculator (see panel at left)—required values are found through rapid calculations based upon other values on the same scale.

Wherever you plan to use the advantages of Hanna Hydraulic Cylinders for dependable push or pull power, you'll want the Hanna Calculator to swiftly determine the exact specifications of all components. Hanna engineers developed the calculator for you—you may have it with their compliments and without obligation. Just write us giving your name, title, company and address.

Hanna Engineering Works

hydraulic and pneumatic equipment . . . cylinders . . . valves . . . riveters

1771 Elston Avenue, Chicago 22, Illinois

Planned Perfection

★ An estimate (of cost) is something much more than a means of determining a selling price. It is the point at which Cinch engineers give the buyer the benefit of their long experience. What is the best way to make it? What is the most efficient machine? Has the proper material been specified? What short cut or simplification of the assembly for economy should be recommended? These and many other considerations are all part of Cinch Service. "Planned Perfection", to our way of thinking, is not an accident—it is passing along our "KNOW HOW" learned through the manufacture of thousands of different metal plastic assemblies. Have you considered what our services can do for you?

MEET MEtal PLASTIC ENGINEERING

CINCH MANUFACTURING CORPORATION

2335 West Van Buren Street, Chicago, Illinois

SUBSIDIARY OF UNITED-CARR FASTENER CORP., CAMBRIDGE, MASS.

No. 4 in a Series of advertisements "MEET MEtal Plastics Engineering"

Heat-sealing thermoplastic films

by WARREN R. GROSS*

SINCE the outbreak of the war there has been a tremendous growth of interest in heat sealing of plastic films. Much of this interest can be traced to the tremendous demands made upon manufacturers to ship their products to all points of the world, often under abnormal conditions.

The highly oriented films which are much used for the packaging of these goods have a high deformation point. Consequently, if two sheets of this material, or the ends of one sheet, are to be joined in a water-tight seal free from wrinkles and distortion, they must be held together through the entire heating and cooling cycle. To meet the need for a sealer which will do just this, Sav-Way Industries in cooperation with the Dow Chemical Co. developed a new unit which combines the principle of the jaw and hot roll type sealers.

In this development three variables in heat sealing were kept in mind—temperature, pressure and time control. By incorporating these variables in our machine we are able to meet the exact conditions we need for the oriented films as well as other thermoplastic films or heat-sealable foils.

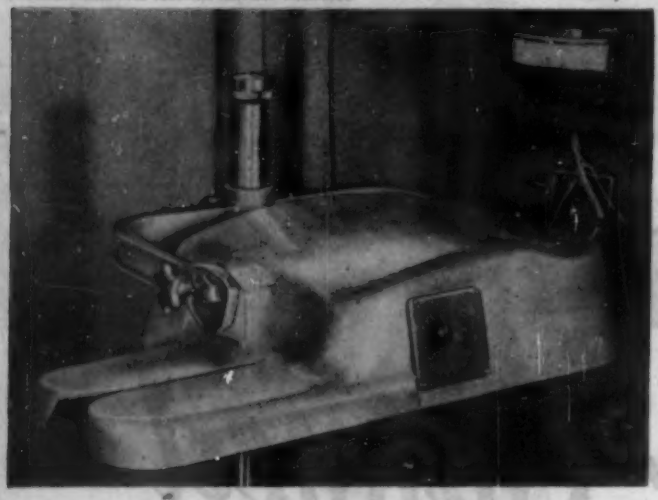
As can be seen in Fig. 2, two thin endless steel belts carry the film through the heat sealer. The film is loaded into one end of the machine and firmly held by stainless steel belts as it is carried into the heating zone, consisting of two opposed copper bars heated by resistance heaters which are accurately controlled to ±1° F. by an electronic temperature controller.

A rheostat connected in series with the two heater shoes allows the operator to balance the temperature of the two shoes. Heat is transferred rapidly through the thin metal belts and film, causing the (*Please turn to page 196*)

* Director of research, Sav-Way Industries.

PHOTO AND DRAWING, COURTESY SAV-WAY INDUSTRIES

1



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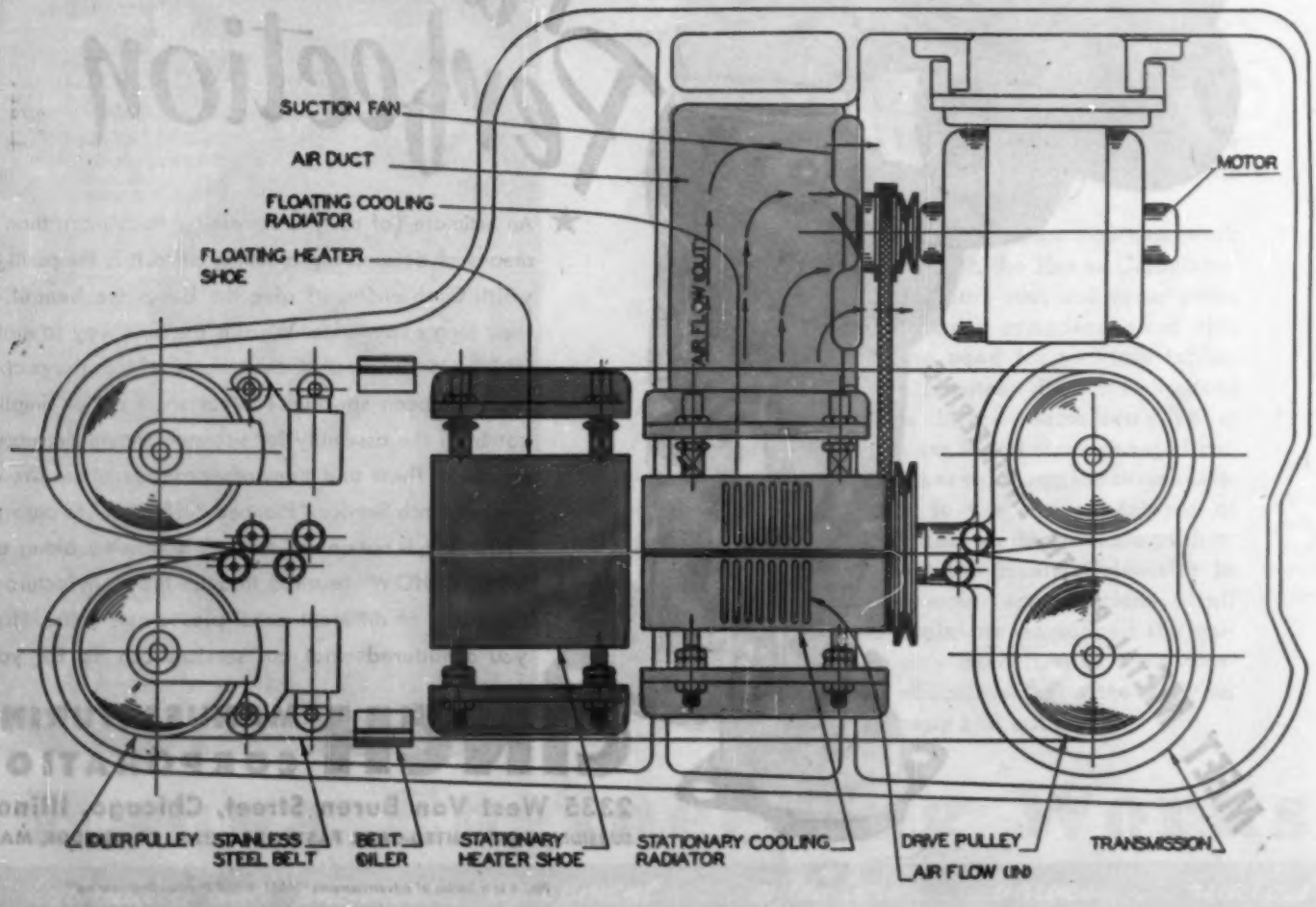
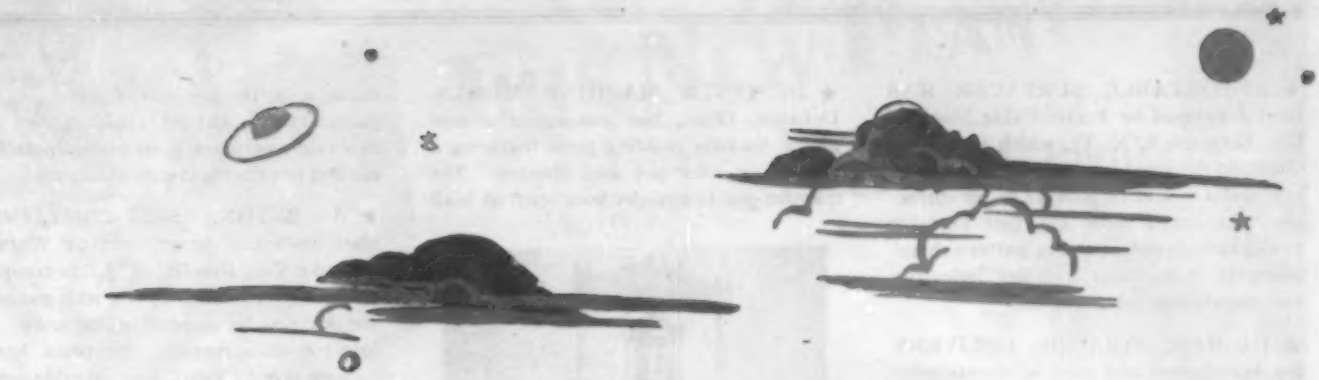


1—The three variables in heat sealing of plastic films—temperature, pressure, time control—are embodied in this machine. 2—In the sketch of the machine's parts, red indicates the heater; pink, the cooling mechanism



Some Day Someone will "Shoot the Moon"

FROM what we know about the development of plastics, we are certain that the future of these infinitely different combinations of chemical substances will lead to advances as spectacular as "shooting for the Moon," and landing on it. Meanwhile we are busy producing closures for containers vital to the progress of the armed forces and the home front. But we will be glad to chat with you about how our resources and research can help you use plastics in the battle for post-war business.

OWENS-ILLINOIS GLASS COMPANY

TOLEDO 1, OHIO

Branches in All Principal Cities

NEW MACHINERY AND EQUIPMENT

★ A PORTABLE SURFACER HAS been developed by Porter-Cable Machine Co., Syracuse 8, N. Y., which is streamlined and designed for durability. Its high belt speed is said to provide faster surfacing. Suggested uses for this portable model include operations in pattern shops, assembly lines, boat building industries and maintenance departments.

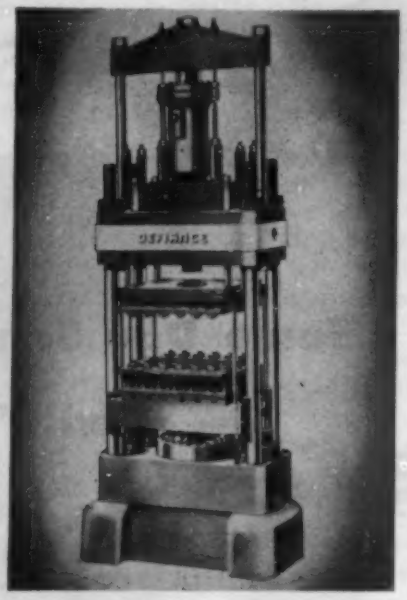
★ HIGHER VOLUME DELIVERY per horsepower and ease of maintenance are said to increase the efficiency of the new line of Superflo centrifugal pumps announced by Gray-Mills Co., Evanston, Ill. These pumps have heavy duty motors in several sizes: 1/3, 1/2, 1/4 and 1/2 hp., with volumes of 9 to 75 gph.

★ MICRO-KING MILL DRILLS, product of Steel Tools, Inc., Cleveland 15, Ohio, are designed for finishing or fabricating plastics, sheet metals, hard rubber and other materials. They are claimed to perform without shattering the plastics between perforations or twisting metals out of shape and to drill perfect holes in a single operation.

★ THERMATRON DIV., RADIO RECeptor Co., Inc., New York 11, N. Y., has introduced a new Thermatron dielectric heater Heatmaster which may be used for heating plastic preforms, for dehydration or for sterilization or other purposes. Designed especially for heavy-duty preheating in the plastic molding industry, ac-

cording to the manufacturer, the unit is self-contained and incorporates a built-in electrode cage, automatic protection, heavy electrodes and long-life radial-fin air cooled tubes. It is said to be capable of heating a 3.3-lb. preform in one minute or a 5-lb. preform in 90 seconds. Foot control and a continuous belt heating oven are accessories which are available.

★ DEFIANCE MACHINE WORKS, Defiance, Ohio., has announced a new plastic transfer molding press featuring a built-in transfer pot and plunger. The transfer pot is straight bore open at both



ends, not fastened to the die but self-sealing with the die. A 4 3/4-in. diameter pot can serve the full capacity of the press. This pot size is said to reduce waste material and to provide for more uniform curing. Close temperature control over a wide range is claimed to be possible with the electrically heated transfer punch.

★ METALLURGICAL ENGINEERS of the Steel and Tube Division, Timken Roller Bearing Co., Canton 6, Ohio, have recently designed a hardenability calculator. Circular in shape, the new slide rule is used for computing the approximate hardenability of steel from its chemical composition and grain size in accordance with standard formulas. Hardenability is of first importance to everyone concerned with the uniform response of constructional alloy steels to heat treatment. A free copy of the calculator may be obtained by writing a request upon your firm's letterhead.

★ AIR CONDITIONING, FULL VISion for the operator, and comfortable sit-down control are features of the cab for overhead traveling cranes which has been developed by Cleveland Crane & Engineering Co., Wickliffe, Ohio. The cylindrical shape of the unit creates a streamlined appearance and eliminates corners and hence blind vision spots. Transparent enclosure panels extending to the floor permit maximum vision in every direction over the area covered by the crane. A self-contained unit, the new cab, according to the manufacturer, may be furnished with any new crane employing magnetic control or applied to existing cranes of any make.

★ A 25-TON, SELF-CONTAINED plain hydraulic press built by Watson-Stillman Co., Roselle, N. J., is compact and easily operated, with a wide range of applications for general utility work. Of four-rod construction, the press has a moving-down ram and double-action cylinder. It operates under 1000 p.s.i. pressure, has a 10-in. stroke, a 15 by 15-in. platen and a 20-in. daylight opening. Load may be varied from 15 to 25 tons by a four-way valve control.

★ SUPERIOR TYPE CO., CHICAGO 13, Ill., has put on the market an automatic machine for printing identification on tubes, bars or extruded shapes in either continuous lengths or cut-off sections. Motor driven and floor mounted, the unit has a lineal velocity up to 240 ft. per min. and is adjustable for stock up to 4 ft. wide. A 6-in. diameter printing head permits copy of a maximum length of 18 in. or a repetition of shorter lengths.

★ ACCORDING TO AN ANNOUNCEment received from the manufacturer, Adel Precision Products Corp., Burbank, Calif., and Huntington, W. Va., Stalock, their new type of self-locking sheet metal fastener, has met the requirements of AAF Specifications No. 25533 and has been approved for listing by the CAA. A one-

piece, resilient, spring steel stamping, the nut is said to grip screw threads all around with full 360° engagement, no lock washers or bearing washers being required. The nut is available in a variety of types and sizes for sheet metal screws or may be formed as an integral part of assemblies.

★ A SPINDLE MACHINE DEVELoped by Kindt-Collins Co., Cleveland 11, Ohio, can be used with a wide variety of milling cutters to machine wood and soft metals; with various sizes of abrasive sleeves as a spindle sander. For sanding, the spindle is non-oscillating; for milling it oscillates. It is said to be particularly applicable to the duplication of small or large quantites of wood or metal pieces.

With this new plant completed and equipped, Amos facilities have been greatly expanded for doing plastic jobs—*and doing them right*—for compression as well as injection molding.

From engineering to finishing, Amos does a complete job of plastic molding—and does it the way you want it, *exactly right.* Amos engineers know how to design the job right—*and they do*—using the right plastics in the right places.

Amos tool makers know how to build dies and fixtures that produce perfect jobs. And they do! Amos production and finishing facilities—with quality control of every operation—assure customer satisfaction with the completed job.

Send us your drawings or write us what you're planning in a plastic job you want done right.

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CUSTOM *Molders of*
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INJECTION • COMPRESSION

WASHINGTON ROUND-UP

R. L. VAN BOSKIRK, Washington Editor

Plastics raw materials availability

Here is an attempt to give as accurate a picture as possible of the plastics raw materials supply situation now and in the near future.

Acrylics—At the end of the German war, production was about 3,000,000 lb. a month, practically all of which was absorbed by the Armed Forces. However, not all of this material was used for airplane components. Water filters used on landing craft took up sizable quantities and there were other applications. How many of these will be cut is still uncertain. Cancellations for planes are still coming in and may be expected to increase and there is a question as to how much acrylic will be used in the airplanes which will continue to be produced. B-29's use more glass than plastics in their noses. But many of the new fighter planes are equipped with bubble canopies instead of the older section canopy and require more acrylic.

If airplane production is cut one-third, there would be 1,000,000 lb. of acrylic available monthly by late summer. But no one knows what the demand is going to be. Outside of the sheeting field, acrylics are used for leather finishing, vitamin synthesis, dentures, adhesives and many miscellaneous molded items such as radio, refrigerator and automotive parts.

Cellulose acetate molding powder—Acetate molding powder production has been around 4,000,000 lb. a month since last year. Military demands increased from 800,000 lb. in September to 1,800,000 lb. in March, then dropped off to 1,300,000 lb. in May and less for June. All the material remaining after slightly more than 1,000,000 lb. is provided for war, is being allocated under Paragraph (*f*). Consequently there will be no more specific allocations made for civilian items, unless the Government eventually draws up a priority listing that will require channeling of plastic parts into such things as refrigerators, automobiles and washers. The plasticizer situation will remain tight for some months to come and will interfere with quantity and quality of acetate powder.

Cellulose acetate butyrate—About 90 percent of production is still for war. It is probable that war uses will require at least from 70 to 80 percent of production as long as armies are in combat. A small amount will be allocated under Paragraph (*f*).

Cellulose acetate sheeting—There is very little sheeting being delivered under (f), and probably there will not be much for several months. There is not much likelihood that sheeting under 0.003 in. will be available in the near future because it is nearly all used in ordnance wrap which will be in greater demand for packaging war goods during the redeployment period. And thicker sheeting requires phthalate. It is probable that capacity for making sheeting will be available long before sufficient plasticizer is available.

Cellulose nitrate—The bottleneck, camphor, has been broken and it is believed that camphor itself will soon go under M-340, which eliminates ratings for civilian applications. Present monthly production of synthetic camphor is far in excess of amounts needed for military applications and Lend-Lease. With the free availability of camphor it is believed that producers of nitrocellulose plastics can now make all the items that their facilities will permit.

Cast resins—For the first time in many months a small amount was made available for June delivery under Paragraph (f). It is expected that this quantity will show a gradual increase.

Dichlorostyrene—There is a surplus on hand. A stock pile was built up at the suggestion of the Army and Navy in anticipation of a demand which did not completely materialize.

Ethyl cellulose—Only off-grade material is available for (f) allocation. Cessation of the war in Europe will have little effect because new and increased war uses are being found for this material. New facilities should reach full capacity by early fall.

Phenolic molding powder—Military demand is showing a sharp decline. More than 1,500,000 lb. was allowed in July under Paragraph (f) for closures, buttons, electric iron parts, washing machines and export. The future depends upon such conflicting factors as availability of benzol (needed for high octane gasoline and rubber) and ability of producers to manufacture molding powder under bottleneck conditions such as manpower.

Polystyrene—Approximately 700,000 lb. were scheduled for July delivery to unspecified civilian uses under Paragraph (f). This means that the entire allocation of polystyrene for civilian purposes was placed under (f). There have been no startling military cutbacks, but improved production methods have increased output. Increased facilities are being talked about, but cannot come overnight. The rubber people have a lock on benzol which is the key material for manufacture of styrene.

Polyethylene—Small amounts are being allocated under (f) for experimental and industrial uses. Army-Navy is experimenting with it for uses other than cable. Uncertainty prevails as to when any great amount may be available for civilian uses.

Urea molding powder—All civilian requests are now under Paragraph (f). The formaldehyde situation, upon which urea is dependent, has been steadily improving; and although formaldehyde is vitally needed for ordnance, there should be no more emergencies such as last winter's.

Vinyl—The vinyl situation is clouded by plenitude of resins, shortage of plasticizers, ceiling price for scrap and rubber subsidy. First, there is far more than ample capacity to supply all military and naval demand for vinyl chloride resin. But there is scarcely enough plasticizer to meet military demand. It is doubtful that there will be enough of the most needed plasticizers until the end of this year.

The most sought plasticizer for fabric coatings is dioctyl phthalate, desired as plasticizer for unsupported film. Other needed plasticizers are dimethyl and dibutyl phthalate. The former goes into insecticides and the latter into gunpowder. Both come from phthalic anhydride, which is the bottleneck. The gunpowder program has been cut but military authorities claim they need the remaining phthalic anhydride for insecticide.

As a result of this unbalance, vinyl chloride producers are in a position to store up great quantities of this material, hoping for the day when it can be moved. They can sell plentiful quantities under Paragraph (f) if they can find a buyer.

Another factor which adds to the general confusion is the institution of new military programs without first ascertaining whether or not material is available. Producers are willing to furnish all military requirements, but in view of the continuous cutbacks and cancellations now under way, it has been suggested that not more than 75 percent of their production should be considered for the military and the remaining 25 percent might be used to maintain that flexibility of operation which military applications disregard.

There is still another evil blossom budding on the vinyl bush. That perennial old lily, "price subsidy," is about to flower again. The auto industry can use a lot of vinyl when it gets going. Such things as window stripping for windows and elastomeric molding jobs such as foot pedals, grommets, valve caps and distributor head caps can be made from vinyl without the use of critical plasticizers. It would be a nice market for the vinyl trade in the near future with so much resin and so little of the more critical plasticizers. But the auto industry will not use it unless the price is comparable to rubber. Rubber can be obtained at the subsidized price of 17½ cents a pound. If rubber were not subsidized, the vinyl price could easily compete.

We time the Punch with *Electrons*

. . . so that it "lands" with the *extra* force needed to fill the die.

In this Reed-Prentice Plastic Injection Moulding Machine, granulated plastic material is forced through a heated cylinder into the die at continuous high speed, under high pressure. Photoswitch Electronic Timer T15U actuates controls within the hydraulic system that provide maximum pressure, *at the exact* instant, with the *fractional second timing required* to complete the injection stroke.

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Photoswitch Electronic Timers function with split-second accuracy . . . without fatigue . . . frictional wear . . . or inertia. Electronic operation eliminates clockwork, springs, mechanical clutches . . . all moving parts subject to wear and failure . . . provides consistently accurate control without danger of speed-up or slow-down, and with extremely long life assured. Photoswitch Electronic Timers are used extensively to initiate automatic operation of precision production grinders, millers, profilers and other machine tools; to insure maximum safety and efficiency in X-ray equipment; to provide split-second control in welding, molding, spraying . . . and to afford the high degree of accuracy needed in process control.

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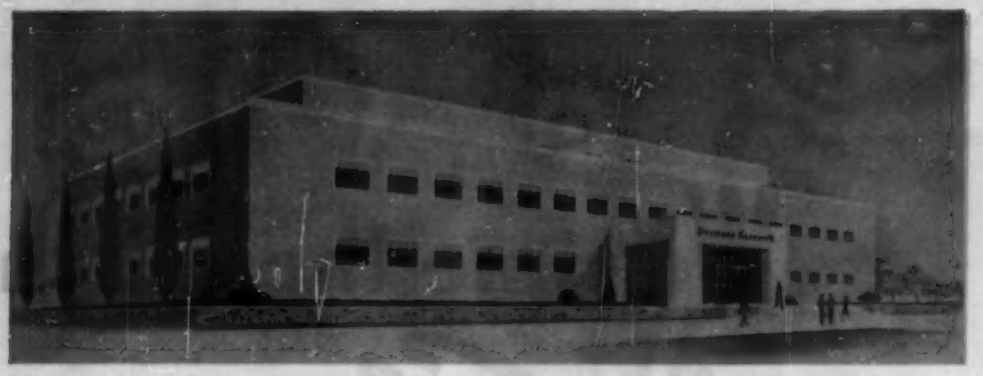

Under the ideal conditions provided by this completely up-to-date laboratory, scientists will have at their disposal the most comprehensive facilities for research and development of new materials

A new research laboratory

RESEARCH, which has proved itself the cornerstone of a great part of the extraordinary equipment to come out of this war, will receive greater impetus with the completion of a two-million dollar research laboratory by Firestone Tire and Rubber Co. Said to be one of the largest and most advanced ever created for the purpose, the new research laboratory will be given over primarily to an extensive program of pure research on plastics developments for the improvement of plastics now in use and the development of new raw materials for the production of plastics products. Process developments will be of but incidental interest to the technicians who will concentrate their efforts on more basic scientific problems—the chemistry, physics and molecular linkage of the plastic monomers. Textile and metal research, as well as that on rubber and plastic products, will be conducted.

The laboratory, built under the supervision of John W. Thomas, chairman of Firestone, comprises two main working floors plus a partial third floor or penthouse. In addition to the laboratories and the offices, three rooms are arranged for special constant temperature and humidity control to be used as an infrared room, an electrical measurements room and a physical testing room, respectively. There is also a large library and an outdoor aging laboratory.

Eight vertical central service shafts carry eight cores of services, including hot, cold and distilled water, steam of 40 to 160 lb. pressure, gas, vacuum, compressed air and a wide variety of AC and DC electrical currents. Walls, ceilings, column enclosures and partitions are of prefabricated insulated steel, all or any part of which may be removed.

Special equipment includes an electronic microscope which magnifies 20,000 times, x-ray diffraction apparatus, a quartz spectrograph and dozens of pieces of equipment specially designed by company engineers. Through the research carried on in this laboratory, materials developed by Firestone which are already veterans of war uses will be further exploited.

Velon upholstery fabric, virtually wearproof, will be available for the transportation field while the new vinylidine chloride filament yarn will open a vast new field of uses for plastic materials. These yarns and fabrics—snag-resistant, impervious to grease and stains, and long wearing—will make possible production of extremely sheer hosiery and fine lingerie and dresses.

Velofilm, developed as a packaging material for war goods, will have numerous postwar uses. Naturally water-repellent, it can also be specially moisture-vaporproofed. It will be used for raincoats, garment bags, shower curtains, awnings and crib sheets. It will also be an ideal packaging material for protection of products which may be harmed by moisture.

Translucent vinylide chloride shades will admit maximum light while holding back the direct rays of the sun

Scientists at work on synthetic rubber developments in a six-man laboratory of the new research building

LEA Method
LEA Compound

. . . economy keys to desirable high-luster buffing

Northern Industrial Chemical Co., South Boston, Massachusetts —"Moulders of Plastics"—is making these parts for telephone instruments.

It's in the preparation for the buffing of these parts that the LEA Method and LEA Compound are helping the manufacturer to cut costs and produce better finishes. As stated by this company, "LEA Compound is working out satisfactorily particularly in removing flash on parts which have been rough sanded . . . LEA Compound allows us to produce a high-lustre on the moulded parts."

Being specialists in finishing and having years of experience and many grades of compositions from which to select, our technical men have been called in by hundreds of plants to advise on how to obtain better finishes at lower costs. Northern Industrial Chemical is one of these companies. If you have any finishing or burring problem in connection with metal, plastics or other non-metal parts, ask LEA how to do it best.

THE LEA MANUFACTURING CO.

Waterbury 86, Conn.

Burring, Buffing, and Polishing . . . Specialists in the Development of Production Methods and Composition

NEWS OF THE INDUSTRY

★ THE ONE THOUSAND DOLLAR prize in pure chemistry for 1945, awarded yearly by the American Chemical Society, was recently presented to Dr. Frederick T. Wall, associate professor of chemistry at the Univ. of Illinois. Dr. Wall received the award for his work on the thermodynamics and statistical mechanics of polymers and for the independence of thought and originality of his research accomplishments.

★ ROBERT M. CRAWFORD WAS recently elected vice-president in charge of engineering of Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y. Also elected to vice-presidencies were Robert E. Dodd, in charge of industrial resin sales, and Alfred W. Hammer, Jr., in charge of molding compound sales. Carl N. Osborne, vice-president and treasurer of M. A. Hanna Co., Cleveland, Ohio, was elected a director of the corporation at a stockholders' meeting.

★ WITH AN APPROPRIATION OF $400,000 approved by the board of directors, plans for the construction of new units to expand the Wilmington research facilities of Atlas Powder Co., Wilmington, Del., are nearing completion, it has been announced. Work on the project will commence as soon as approval is received from the W.P.B.

★ NEGOTIATIONS HAVE BEEN completed by Dow Chemical Co. of Canada for the building of a new plastics plant at Sarnia, Ontario, to produce styrene. The new plant will be situated adjacent to the Government-owned synthetic rubber plant of the Polymer Corp. from which it will obtain its raw materials.

★ DR. KENNETH B. GOLDBLUM has recently been appointed group leader in charge of the research and development section of the chemical laboratory of General Electric Co., Pittsfield, Mass. Roger Rice has been promoted to fill the position of group leader of the standards and testing section of the Chemical laboratory, formerly held by Dr. Goldblum. Philip E. Doell, in charge of resin and insulation material sales in the East Central district since 1936, has been appointed district manager of the company's newly formed chemical department in the same district.

★ ACCORDING TO WORD RECEIVED from the U. S. Patent Office, there has been established a Register of Patents Available for Licensing which will be maintained in that office. Patents recorded on this register will be available to the public for inspection in Washington, D. C. This service has been put into operation in order to bring to the attention of industry and inventors patented inventions under which the owners are willing to grant licenses on reasonable terms, with the hope that such information will lead to greater employment opportunities in the reconversion period.

★ THE SOUTH GATE, CALIF., FABRICATING plant of Rohm & Haas Co., Philadelphia, Pa., has been sold to Shellmar Products Corp., Mt. Vernon, Ohio. This transaction, according to the announcement, is in keeping with the company's established policy of withdrawing from commercial fabrication of Plexiglas, with the exception of any work necessary for the development of improved fabricating processes which will be carried on at the Bristol, Pa., plant.

★ DETROIT WAX PAPER CO., River Rouge, Mich., will henceforth be known as Fabricon Products, Inc. Coincident with the announcement of the change in name a new unit, designed to house the plastic and fiberboard division of the company and equipped with new machinery, has been put into production.

★ EXECUTIVE OFFICES OF UNITED States Plywood Corp. have been moved to the Weldwood Bldg., 55 W. 44th St., New York 18, N. Y. The company's warehouse will continue to operate at 616 W. 46th Street.

★ RESIGNING AS GROUP LEADER at Central Research Laboratories of Monsanto Chemical Co., St. Louis, Mo., Raymond B. Seymour has accepted an appointment as Director of the Chattanooga Institute of Industrial Research.

★ GEORGE L. BACHNER, TREASurer of Midland Die & Engraving Co., Chicago, Ill., has been given the additional post of vice-president. Nils Rundgren, plant superintendent, will be assistant treasurer.

★ RECTO MOLDED PRODUCTS, Inc., Cincinnati, Ohio, this year observed its 25th anniversary in the plastic industry.

★ CHARLES F. MARSCHNER HAS recently joined the staff of Forest Products Laboratory, Madison, Wis.

★ THE PLASTICS MATERIALS Manufacturers Association safety awards were recently presented to five member companies who completed the last quarter of 1944 without a lost-time accident. Recipients of the engraved plastic plaques were representative of E. I. du Pont de Nemours & Co., Inc., Leominster, Mass., plant; B. F. Goodrich Chemical Co., Niagara Falls, N. Y., plant; Tennessee Eastman Co., Kingsport, Tenn., plant; Plaskon Div., Libbey-Owens-Ford Glass Co., Toledo, Ohio; and Makalot Co., Boston, Mass.

★ THE CHARLES B. DUDLEY medal has been awarded by the American Society for Testing Materials to William N. Findley, assistant professor of theoretical and applied mechanics, Univ. of Illinois. Dr. Findley received his award for a paper entitled "Creep Characteristics of Plastics," which was presented at a meeting of the Society in February 1944.

★ THE TRANSFER OF ECLIPSE Moulded Products Co., Milwaukee, Wis., to General American Transportation Corp. has recently been disclosed. Eclipse Moulded Products Corp. will continue operations under the same management.

★ ALLIED APPLIANCE CO., LOS Angeles, Calif., has announced that it will henceforth be known as Allied Appliance and Plastic Co. Under its new title the company plans to broaden its facilities by the addition of a plastic division specializing in designing, fabricating and molding of plastic parts. The new division will be headed by R. B. Gutset.

★ ANNOUNCEMENT HAS BEEN made that Bernard Schardt, plant manager, and Harry Knight, sales manager, have been admitted to partnership in Creative Printmakers Group, New York, N. Y. Constantine Velonis, a former partner, has terminated his association with the firm.

★ ERNEST W. HALBACH HAS RECently been elected to the presidency of Bolta Co., Lawrence, Mass.

★ BERNARD W. REICH, FORMerly sales manager of G. Felsenthal & Sons, Chicago, Ill., has joined the Industrial Packaging Co., Inc., Brooklyn, N. Y., as sales manager of the Plastics Packaging Division.

★ THE APPOINTMENT OF ROY E. Lounsbury as general manager to succeed W. L. Walker has been announced by Universal Button Fastening & Button Co., Detroit 16, Mich., and Walkerville, Ont., Canada.

Sorry!

★ In the short article describing the sextant distributed by Graham Products, Inc., which appeared on page 125 of the July issue, Franklin Plastics Div., Robinson Industries, Inc., were not mentioned as the molders. The Dillon-Beck Manufacturing Co. does the assembly work on this instrument.

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so easily!

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That revolutionary, new, quick-setting plastic adhesive is *Pliobond* . . . developed by American industry for solving wartime production problems. Pliobond firmly joins any materials . . . like or unlike . . . metals, plastics, fabrics, glass, rubber, wood, paper, plaster, leather, concrete, etc.

With Pliobond most applications need no high pressure or heat. For exceptionally high shear strength, moderate pressure and 200-300°F. are sufficient.

Other important characteristics of this remarkable new adhesive: It's strong . . . permanent . . . withstands constant flexing . . . sets quickly . . . is immune to fungi . . . resists water, oils and wax.

Pliobond is always ready for instant use. Because it is a *one*-part bonding agent, there are no fussy mixtures . . . no exact weighing. It can be brushed, sprayed, spread or roller coated.

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PHOTOS, COURTESY SHOE COVERS CORP.

Shot from a spray gun in an even film over the surface of acrylic plane parts, this protective coating serves as a shield against scratching and contact with foreign matter during forming and shipping. It peels off readily when the part is completed

Protective coating for acrylics

The optical properties of transparent plane enclosures are protected during fabrication by spray masking. This coating forms a tough protective skin that can be retained during subsequent handling

NOT all the ammunition fired from guns is destructive. There's a product,[1] a liquid compound which is discharged from air-pressure guns against such targets as acrylic bomber noses, plane turrets and cabin enclosures. The function of this liquid ammunition is to safeguard transparent surfaces during fabrication, thus helping to preserve the good optical properties of plane enclosures so essential to split-degree accuracy in gun sighting. Applied to the surface of acrylic sheeting, this new synthetic coating hardens quickly, forming a tough protective skin.

The liquid compound is a development born of wartime necessity, an adaptation of a process originally utilized for the protection of fabrics and fine leathers. By this early process, which was used extensively in the United States and in Europe before the war, a coating produced from a rubber latex base was applied to leathers and fabrics prior to their manufacture into shoes. The film remained on the products until completion of the article, then was stripped off.

When the war closed American and European outlets and cut off supplies of rubber latex, the manufacturer of the original spray masking, undertook intensive research to develop a replacement for rubber latex. Many materials were tested and discarded before a compound was produced which gave the essential protection required.

The chief advantage of this compound is that it provides complete protection to the acrylic sheeting—safeguarding the surface from scratches, abrasion, action of foreign materials and damage during all fabricating and assembly operations. Being a translucent material, it permits the transmission of enough light to permit operations to be conducted on the interior of the aircraft. This is in contrast to other methods of protection, such as the use of paper, which completely blocks the admission of light from the outside. When transparent plastic parts are coated in this manner, the assembled airplane may be completely spray painted with priming coats, paints or enamels without danger to the acrylic sheeting as long as the synthetic film is held to a maximum thickness of 0.0026 inch.

Since acrylic sheeting may be machined, sawed or formed while covered with this coating, the compound should be applied before these operations are started. Paper masking should be removed from the transparent sheets prior to spray masking at a point as near the spraying station as possible. By so doing, the scraping of one sheet against another and exposure of the plastic to the dust, dirt and vapors that may be present in the plant are avoided. Operators are cautioned against coating acrylic base plastic which may be scratched or excessively dirty. Any large foreign particles on the surface of the plastic sheet prior to spraying will be trapped between the film and the transparent sheet and cause an impression to be made on the acrylic.

Care must be observed to keep the compound itself free from dirt. Containers for this liquid coating must be carefully cleaned before being filled, and the filled containers must be opened with care to prevent foreign particles dropping into the compound. The coating is then stirred thoroughly.

The compound is strained as it is poured into the tank or pot used as a reservoir. Such straining may be done through a piece of cheesecloth stretched over the reservoir. This procedure filters out any small foreign particles that might otherwise tend to clog the feed line or spray gun.

The coating is applied with a pressure-type spray gun;[2] a suctiontype should not be used. (*Please turn to next page*)

[1] Spraylat, product of Shoe Covers Corp.

[2] Equipment recommended by spray-gun manufacturers which has proved satisfactory in service are MBC spray gun with FX or FF nozzle and No. 765 cap, De Vilbiss Co.; No. 14 B spray gun with NE 3M spray nozzle and cap, Spray Engineering Co.; Thor Model No. 17 spray gun with 63 C fluid tip and nozzle and 63 PB air cap, Binks Mfg. Co.; and No. 25 spray gun with 88 K spray head, Crown Spray Gun Mfg. Co.

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For Transfer Molding Operations — Use Top Cylinder

W-S BUILDS COMPLETE LINE

of Molding Equipment

- Vertical Injection Presses
- Horizontal Injection Presses
- Compression Molding Presses
- Angle Molding Presses
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- Heating & Chilling Presses
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- High Pressure Pumps
- Accumulator Systems

HIGH SPEED—Saves time on die clamping ... important when using heat in compression or transfer.

SELF-CONTAINED—Oil reservoir, pump and motor located in base ... sealed to protect against dust or dirt, but easily accessible for maintenance ... no outside piping.

AUTOMATIC CYCLE CONTROL—Push-button control of all operations eliminates manual labor ... gives controlled production and uniform cures.

DUAL PURPOSE—Easily adapted to transfer method of molding by addition of top cylinder ... efficient and economical transfer of thermo-setting materials using more economical dies, producing improved moldings at greater speed.

QUIET OPERATION—Radial, variable-displacement pump and most moving parts are enclosed—quiet operation even at highest speeds.

SIZES—These presses are available in nine sizes from 50 to 1200 tons capacity ... presses of 500-ton capacity, and upward, are equipped with an auxiliary gear pump that permits low and high pressure speeds.

DE-GASSING—This important operation controlled by timer, instead of limit switch. Speeds production by reducing set-up time.

PUSH-BUTTON CONTROL—All operations set in motion, or stopped, by push buttons ... mechanical-hydraulic knockouts returned by push button ... large palm-button assures safety of operator.

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Air pressure to atomize the compound should not be under 55 p.s.i. at the gun or over 60 pounds. While pressure on the material in the spray pressure tank must be sufficient to deliver an adequate volume of the compound to the spray gun, care should be exercised lest excessive pressure at the tank deliver too great a volume to the gun, with resulting high losses, "running" and waste of masking compound due to the overloading of the surface of the part being masked.

Volume of delivery

The volume of compound that should be delivered at the gun for good operation will vary with the speed of the operator, the type and setting of the gun, the pressures used, the temperature and the viscosity of the compound. As a guide to optimum conditions of atomization for the application of a film of uniform thickness, a maximum flow of 8 fluid ounces per minute from the gun is recommended.

The amount of compound being delivered per unit of time may be measured conveniently by shutting off the air for atomization which enters the spray gun at the handle. Pressure on the trigger will then release the fluid to flow under pressure from the reservoir tank. After discharging the gun into a container for a specified time, the amount of liquid compound delivered per minute may be determined by measuring the contents of the container.

To obtain a proper spray, the nozzle of the gun should be held about 8 to 10 in. from the plastic sheet and the gun adjusted to give a fan- or oval-shaped spray having a pattern length of approximately 8 to 10 inches. A "wet" film is deposited under these conditions whereas a dry film is deposited when the gun is held too far away from the surface.

It is important that a free-arm motion is used by the operator in stroking the spray upon the plastic surface. However, in swinging the gun the operator must be careful that the distance from the gun nozzle to the plastic is not varied from start to finish of the stroke. The contour of the object being coated must be followed with the nozzle held at a uniform distance from the surface throughout the stroke or an uneven film and heavy waste of the coating will result.

On curved plastic sections where the curve is too sharp to be sprayed in a horizontal direction, the position of the gun or the object should be altered so that spraying is done in a vertical direction. Further, when a stroke has been completed it is essential that the position of the gun be shifted for the next stroke so that this next application overlaps on half the film applied on the preceding stroke. If the gun is moved too far an uneven film will result—with some areas covered by too thick a coating while others are too thinly covered. Too short a shift in the position of the sprayer will result in sags and runs, and excessive accumulation of the compound, due to too heavy deposits of the compound.

All recommendations on the care of the guns and arrangement of equipment, given by manufacturers, should be observed. Blocked or dirty caps distort the pattern of the spray and result in uneven films. Clean air is indispensable. A filter should be used in the air line to remove oil and foreign matter from the air to prevent contamination of the compound in the pressure tank or in the gun. These filters should be drained at least once each day and repacked according to manufacturers' instructions. Spray guns, tank and fluid lines must be cleaned out at least once a week using only soap and water.

Drying effects

Films when dry should be uniform and have a minimum thickness of 0.0025 in. to withstand severe abuse or the solvent action of paints and enamels. A thickness of 0.003 in. is recommended when the coating is applied to items after they have been formed, whereas a proportionally heavier film is recommended when it is applied before forming.

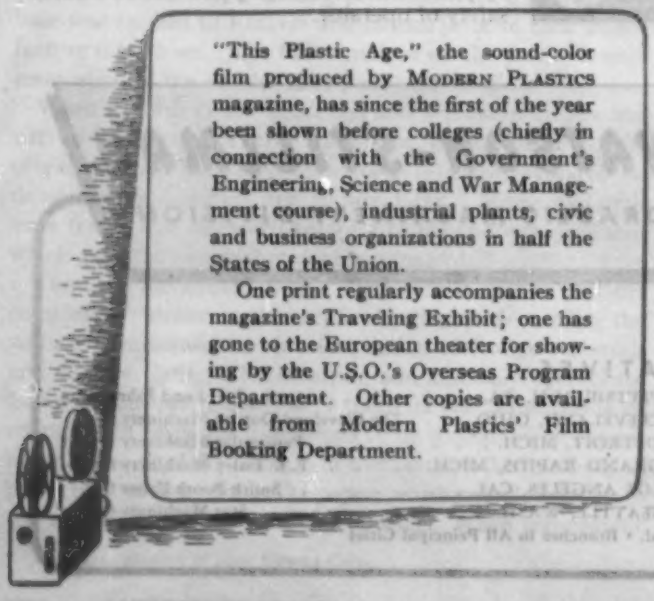
The films may be dried at room temperature or at higher temperatures up to 115° F. Circulation of room or heated air accelerates drying. For the elimination of tacky or sticky film surfaces it is recommended that the coating be dusted with flake mica or talc after application.

In the forming of acrylic resins covered with this coating, the suggested procedure is to suspend the sheets in the heater during the process of softening the plastic so that the film surface is not injured. Mica or talc should be dusted on the coated surface to prevent the film from adhering to the mold during actual forming. Coated plastic sheeting can withstand a temperature of 300° F. for the softening period. Though the cover will be softened somewhat, upon cooling it will regain its tensile strength.

Acrylic sheets coated with the compound may be sawed, ground, drilled or routed without damage to the film. A fine-toothed saw is necessary for a clean cut; rough or coarse-toothed saws will fray the edges of the cover and may expose some of the plastic during fabrication. Holes may be drilled and countersunk in coated plastic parts and the opening will be clean-cut and free from particles and edge-fraying. Covered acrylics may be readily ground, and particles of shavings from drilling or grinding may be blown off with an air gun. It is advisable, however, not to use too great a force of air nor too large a volume lest the protective coat be loosened.

These coatings may be removed quickly and easily from turrets, domes and airplane windows. The tensile strength of the film is high, and the degree of adhesion between the film and the plastic glass is adjusted to prevent the film's being blown off while permitting easy removal when desired. In cases where the film extends under the framework, removal of the film may be easily accomplished by cutting the film at the framework with a dull metal, wood or plastic knife.

This, in short, is the story of a new sort of ammunition—one with a definite record of constructive achievement. Use of this protective coating has resulted in substantial savings of critical acrylic sheeting. It has effected a reduction in labor and time of fabrication and insured the plastic against damage during machining, assembly operations, shipment and storage.



"This Plastic Age," the sound-color film produced by MODERN PLASTICS magazine, has since the first of the year been shown before colleges (chiefly in connection with the Government's Engineering, Science and War Management course), industrial plants, civic and business organizations in half the States of the Union.

One print regularly accompanies the magazine's Traveling Exhibit; one has gone to the European theater for showing by the U.S.O.'s Overseas Program Department. Other copies are available from Modern Plastics' Film Booking Department.

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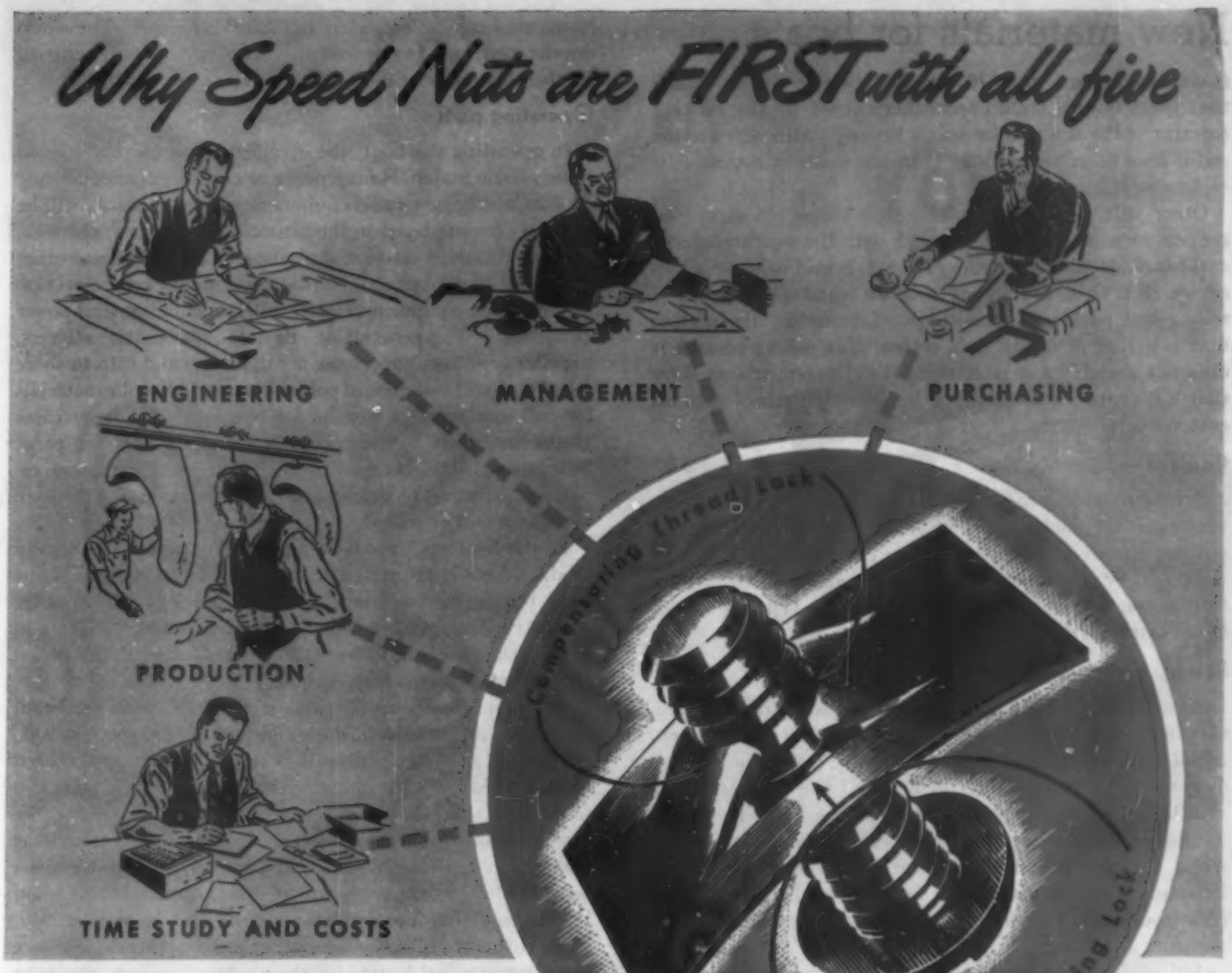

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FASTEST THING IN FASTENINGS . . . OVER 3000 SHAPES AND SIZES

New materials for boats

(*Continued from page 102*) the friction in the nylon sail that there is in a cotton spinnaker caused by the rubbing together of the almost microscopic linters. Although a nylon sail is four times more costly than one made of cotton, it is said to wear much longer.

Other sails, however, require a rigid shape. A saponified acetate yarn, a fiber of zero stretch with the weathering and anti-fungicidal characteristics of nylon, is said to make a fabric which is light and strong and can stand a great deal of rolling and packing into sailbags. Like nylon, the acetate fiber is lighter in weight than cotton when sailing because it does not absorb spray moisture. Weight comparisons show that a 6-oz. rayon of this type has the strength of a 10-oz. cotton fiber.

Cordage

Synthetic fibers may be used where elasticity rather than tautness is required, e.g., in a hawser. Polyamide fibers will outlast most vegetable fibers, for they are unaffected by salt water. They offer, moreover, greater strength for size. Other light synthetic fiber ropes of the non-stretch type are vinylidene chloride and high tensile rayon.

Paints

When synthetic resins for paint formulations first appeared, they offered an important property for a marine paint—exceptional hardness. But they were then very high in price. Today, no paint manufacturer denies that the synthetic resin vehicle is the most durable as well as the quickest drying. Synthetic resins in special paint formulations for wood and metal, for interior and exterior, for topside and bottom, and for enamels and varnishes offer superior weathering qualities, great toughness, resistance to alkalis and corrosion, and to moisture and vapor.

Although phenol-formaldehyde resin in combination with tung oil is one of the best combinations for most marine formulations, alkyd resins with domestic long oils have come to the front during the war period as excellent finishes for naval craft.

Varnished panels exposed to atmospheric conditions in Florida showed that a phenolic type spar varnish had not lost its gloss after 6 months whereas the old-fashioned varnishes based on fossil resins, or rosin and ester gum had failed badly after three months. As for moisture absorption, a test conducted by the Forest Products Laboratory proved that after 48 weeks of exterior exposure, all other types of varnish had failed, giving zero moisture protection. The phenolic resin spar on the other hand, was in good condition and offered a higher protection value than any of the others. "Most yacht whites discolor badly in fouled waters because they are not made to resist the hydrogen sulphide gases arising from them," says one manufacturer of resinous marine paint. "A resin based paint resists them to a remarkable degree." Further, resin vehicle engine finishes are not affected by gasoline or oil; and resin vehicle spar varnishes yield maximum build with least number of coats. Retention of color, a matter of film integrity, is provided by the tougher synthetic resin vehicles.

Bottom paints

Fighting "seabeard" by keeping the anti-fouling paint film soft and allowing the poisonous agents to attack barnacles and other fungi freely is the job of methyl dihydrobitate and tricresyl phosphate plasticizers, cuomarone indene and vinyl resins used as paint extenders and softening resins. These new developments used extensively by the Navy are as yet untried by the pleasure boat industry.

Operating parts

In operating the boat, the excellent dielectric qualities of some plastic materials may prove of consequence, depending on how widely new radio equipment and instruments will be used on pleasure boats in the future. Polystyrene, phenolic, laminated molded macerated plastics, methacrylate and other resins will be used in conjunction with salinity cells, direction finders, sonar equipment, electric telegraph and general power equipment. Fog-penetrating devices, automatic steerers, impeller type logs, supersonic depth finders and ship-to-shore telephones will make use of polystyrene and phenolic materials for coil insulators as well as for housings. In many cases plastic materials will supplant bronze and brass for panel boards and dials because of their improved corrosion resistance, lightness of weight and the ease with which they are fabricated and engraved.

Plastic bearings have been and will continue to be widely used. Cloth impregnated with phenol-formaldehyde resins form tough, hard-wearing laminated bearings for propeller shafts, rudders, pintle bushings and stern tubes. Lighter in weight, they are said to wear three times longer than wooden bearings and not to crack or split.

Other plastic operating parts which have seen successful service are phenolic-molded distributor heads, throttle valves, laminated grommets, propeller screws which are coated against abrasion with phenolic coatings, and gear housings. Condenser tube inserts of phenolic-molded plastic save the condenser tube, which is subject to rigorous testing, from wear and abrasion. The Owens Yacht Company has given serious consideration to the replacement of brass, metals and wood by plastics to reduce production costs and increase utility. In addition to plastic sleeves, grommets, insulation fuze sockets and panel boards for the electrical system, this boat firm uses synthetic elastomers for connections on the water-cooling system to replace rubber.

The company also employs synthetic material for shock absorbing and deadening engine supports (pat. pend.) to reduce noise and vibrations and assure engine alignment, for a flexible coupling (pat. pend.) to transmit power to the propeller shaft (where it absorbs propeller shaft vibrations), for a flexible log which keeps water from creeping in as the shaft rotates (offering the advantage of oil resistance), for flexible connections in the gas line, and for a shock-absorbent flexible stern bearing on the propeller (pat. pend.). This bearing has a phenolic fabric laminate surface which makes possible self-lubrication by water and prevents electrolysis of the shaft material which occurs with a metal bearing. The Owens Flag Ships also use vinyl tubing fittings to replace copper in the freshwater system, eliminating the cupric acid taste.

A recent development is the use of methyl methacrylate to replace glass in filters and as tubular lenses for port lights. A new resin based ignition coating, brushed on the ignition to prevent failures from water immersion, is a development which should prove of interest to yachtsmen.

Windshields and windows

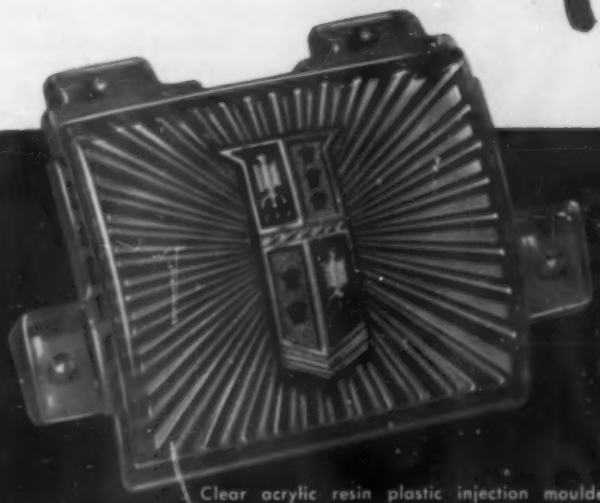
Naval architects have long been intrigued with the possibility of using acrylic materials for windows, windshields and other transparent enclosures because of the ease with which the plastic can be shaped into compound curves. One materials supplier[2] claims that his acrylic material is a satis-

[2] Rohm & Haas Co.

UNDER ONE BIG ROOF AT AUTO-LITE

Beauty and Utility

IN PLASTICS
IN METALS



Clear acrylic resin plastic injection moulded ornament with enamel filled in reverse side to give High Lite finish.

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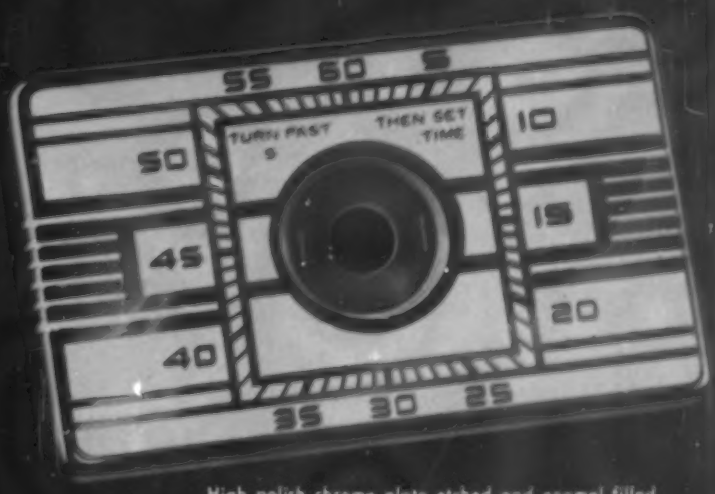
Polished aluminum lithographed name plate. Blanked and pierced, then embossed.

Tire valve cap, door bumper and oil hole plug of elastomeric vinylite injected moulding.



High polish chrome plate etched and enamel filled brass escutcheon. Blanked and pierced, formed.

Etched aluminum register dial with anodize finish. Blanked and pierced, formed.

America is finding out most products are more salable when they are made beautiful—and so often the change is easily accomplished. Here, under one big roof, are the technical skills and the equipment which provide decorative developments in both plastics and metal.

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PLASTICS AND METALS

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Tune In "Everything for the Boys" Starring Dick Haymes — Every Tuesday Night — NBC Network

Ten plastics training films

by ALEXANDER KLEIN*

As part of this war-training program, the U. S. Office of Education recently sponsored the production of a series of ten instructional films on plastics, designed primarily to facilitate training of new personnel and shifting of old employees from one type of job to another. The films were planned and produced by our company, in cooperation with the educational committee of the Society of the Plastics Industry, the Plastics Industries Technical Institute, and H. J. DuBois, who acted as technical adviser.

Although we made a thorough survey of the industry before deciding on the subject matter of the films, we had to consider a number of limiting factors. Only ten films were to be made, a limited budget was available, and war production conditions eliminated some plants from our shooting schedule. Photographing inevitably involved some interference with production, but the executives of Shaw Insulator Company, Tech Art Plastics, Synthane Corporation and Irvington Varnish & Insulator Company, at whose plants we did the shooting, considered the project sufficiently important not to let that stand in the way.

The first two films are of an introductory or informational nature. Film 1, *Origin and synthesis of plastics materials*, shows the synthesizing of two typical plastics, one thermosetting and one thermoplastic, and indicates the basic types of processes involved in synthesizing all plastics. Animation and laboratory-scale demonstrations are used to show the process clearly. The film closes with an extended sequence of shots of many types of plastics products in use, illustrating the variety of properties enjoyed by plastics materials.

Film 2, *Methods of processing plastics materials*, shows in highlighting form the many ways in which plastics materials can be manufactured into end products, including: compression, transfer and injection molding; extrusion and laminating; machining and finishing. The basic steps and processes involved are covered in each case, as well as the use of the particular manufacturing method. The processes of preforming and preheating, their uses and advantages are also pictured.

The other eight films are job-training films. Each film opens with an over-all view of the job, is followed by a careful picturing of specific steps and precautions.

Films 3 and 4 cover the *compression molding* of a simple piece which involves no inserts. Basic points covered include: accurate weighing of the charges, if powder is used; preheating preforms; thorough cleaning of the mold halves; gradual closing of the mold; correct curing time; and use of cooling fixtures, when required. The end-results of incorrect practices are shown and the importance of a coordinated sequence of operations for a high production rate emphasized.

The same basic technique is used in the other six films: 5) transfer molding of parts with inserts; 6) semi-automatic and hand molding of intricate parts; 7) injection molding and setting up of the press; 8) cleaning and servicing an injection press; 9) finishing of molded pieces; 10) machining of laminated plastics.

Prints of the pictures will soon be available to the public at a nominal cost, from Castle Films at 30 Rockefeller Plaza, New York City. The longest picture (2) which runs about 25 min. will cost about $30; the others will probably range from $15 to $25.

* Executive producer, Caravel Films, Inc.

factory replacement for glass in many applications on shipboard only recommending that care be exercised in removing salt encrustations before wiping so that salt crystals will not be scoured into the surface. Hosing or flushing with plenty of water should, however, prevent possible difficulties.

Fittings and furnishings

One company, specializing in marine hardware for pleasure boats, has over 5000 items in its line. Any owner of a sailboat knows how many little items such as pulleys and tackle blocks, screws and rings, are constantly being needed on a boat. Although marine fitting companies are most enthusiastic about the reduction in weight, corrosion resistance, improved appearance and simplified production offered by plastic materials, they question whether the savings that would result from using molded fittings rather than wood and brass would not be offset by the cost of high-pressure injection and compression molds.

There is a need for the development of plastic plumbing fixtures, says one naval architect. Lightweight, non-corrosive plastic flush valves, sleeves, pipes, tank floats and other war developments in plumbing will be bound to have a place in the marine field.

Boat owners who used laminated plastic sheet material for table tops, galley flat surfaces, molding trim, bunk trimmings and bureau tops before the war will welcome the return of these and similar materials. One architect asks, however, that materials suppliers stop marbelizing and imitating wood materials. "Give us plain colors for floor coverings, table tops, wall veneers, and we will do our inlay work," he says.

Vinyl resins and synthetic fiber materials will make yacht housekeeping much easier because of their resistance to scratching, water, oil and grease. And when the war is over, rigid and elastic molded materials for molding trim, bunk trimmings, door knobs and drawer pulls will be welcomed back into pleasure craft.

Acceptance at the waterfront means product prestige

Because of the tough conditions that marine products must withstand, and because of the devotion with which materials are selected for boats by their owners and builders, products used by yachtsmen are usually well thought of by the layman.

The future for plastics in the boat industry is anyone's guess—it may come up to highest expectations; it may remain at its prewar level. But it is clear that whatever the future holds, plastics materials are inevitably bound up with the boat building field.

Acknowledgments

We wish to thank the following companies and individuals who have so generously donated their time and information to the preparation of this article.

Material suppliers: Hercules Powder Co., Inc., Rohm & Haas Co., Durez Plastics & Chemicals, Inc., Bakelite Corp., E. I. du Pont de Nemours & Co., Inc., Columbian Rope Co., Celanese Plastics Corp., Resinous Products & Chemical Co.

Molders and laminators: Gamble Bros. Inc., Allied Aviation Corp., Duramold Div., Fairchild Engine and Airplane Corp., U. S. Plywood Corp., Virginia-Lincoln Corp., Duralyt, Inc., Columbian Rope Co.

Manufacturers: Hudgins and Ratsey, Miracle Adhesives Corp., Bendix Aviation Corp., Marine Div., International Paint Co. Inc., E. J. Willis Co.

Architects and industrial designers: Donald B. Abbott, William W. Atkin, Egmont Arens, Richard B. Davis, Joseph B. Federico, William J. Deed, George G. Sharp, Masterson & Schlegel, Sparkman & Stephens, P. L. Rhodes, J. Murray Watts, John H. Wells, York Research Co., Fred K. Lord.

Boat builders: Doane Marine Works, Luders Marine Construction Co., Owens Yacht Co., Higgins Industries, Inc., Gordon Douglass Boat Co., Penn Yann Boats, Inc., Wheeler Shipbuilding, Corp., Electric Boat Co., Ventnor Boat Works Inc., Richardson Boat Co.

Also: Glenn L. Martin Co., Yachting Magazine, American Bureau of Shipbuilding, Cotton Textile Institute, National Assoc. of Engine & Boat Mfgrs.

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Heat-sealing films

(*Continued from page 178*) sheets of thermoplastic film or heat-sealable materials to flow together. From the heating zone the belts carry the softened film into a cooling zone that is air cooled.

Pressure on the material is achieved by having one of the heating shoes solidly mounted, but equipped with adjusting nuts for proper alignment. The second bar is floated, being held against the fixed shoe by springs. With this spring-loading arrangement materials of different thicknesses pass through the machine. Pressure is easily raised or lowered by adjusting the tension on the springs of the floating shoe. Pressure on the cooling shoes can be similarly adjusted.

Timing is controlled by regulation of the speed of the steel belts. This may vary from 20 to 25 ft. per min. on smaller types of machines to 35 ft. per min. on larger models.

Due to the special design of the heater bar faces, a seal is obtained that we refer to as a temperature gradient seal. The belts, carrying the material through the shoes have more heat concentrated through the middle than near the edges. This gives a weld line that has the stress points distributed evenly.

Tests have been made on many types of packaging film. Among these were polyvinylidene chloride, rubber hydrochloride, polyvinyl chloride and polyethylene film. In the future the applications of the machine may be greatly expanded as a result of the very interesting work being done on the heat sealing of many of the resin-impregnated and coated cloths, rayon cotton and nylon.

The unit has been designed so that it may be easily adapted to a variety of applications. The sealing head may be tilted in a 90° arc so that an operator may easily hand feed all different sizes of light packages. Or this same head may be mounted on a monorail to facilitate the sealing of large containers such as complete aircraft engine bags. A conveyor type machine with the belt synchronized with the speed of the sealing head has been developed for heavier packages. With this arrangement a box moves along the conveyor belt and the top of the bag, which has been placed in the sealing head, goes through the length of the machine and emerges sealed.

Effect of molding pressure

(*Continued from page 148*) three panels molded at low pressure were compared, it was found that panel 207 molded with resin *B* had the best properties in eleven out of fourteen items. It had a specific gravity slightly higher than panel 205, a tensile strength inferior to that of panel 209 and had the lowest impact strength of the group.

No account was taken of the specific gravity in comparing the properties of the six panels so that the low pressure panel of resin *B* may be as good or better (depending on the property and application) than the high pressure panel with resin *B*, for applications where weight is a prime factor.

Acknowledgment

This project was carried out as a part of the work of the Engineering Experiment Station of the University of Illinois, Dean M. L. Enger, director, in the Department of Theoretical and Applied Mechanics of which F. B. Seely is head. The authors are indebted to F. B. Seely for assistance in the preparation of this manuscript. The authors wish to express their appreciation to the Forest Products Laboratory for preparing the samples and supplying the information quoted above. A part of tests reported herein were conducted as a senior thesis by C. D. Kacalieff.

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[13] See A.S.T.M. Method D 671–42 T, "A.S.T.M. Standards," Part III, 1942, p. 1251.

Fabrics for laminates

(*Continued from page 154*) in strength of the grey goods was about 20 percent more than it was for sanforized fabrics. The work was in fair agreement with the theory that multi-ply laminates should have tensile strengths which are multiples of those of single-ply laminates.

The most striking observation concerning water absorption was the fact that more than 50 percent of the total weight increase occurred during the first half hour. Starch sizing tended to cause higher water absorptions and, if the fabric had been dewaxed, the weight increase was still greater. The rate of water absorption was less for sanforized fabrics, and the final weight increase was slightly less. After aging, the neutral resin laminates exhibited lower water absorption rates and lower weight increases than any of the others.

Preshrunk fabrics withstood drawing to a greater extent than unshrunk goods. In general, the degree and manner of shrinkage determined the character and amount of draw that could be obtained from a given fabric.

A *definite* relationship between warping and fabric construction has been established, but *none* appeared to exist between it and fabric pretreatment or water absorption. Water and aging increased the warping tendency but did not cause it, as certain fabrics did not warp. The work has indicated that the torsional stresses in the yarns cause warping and that they must be neutralized in some manner to obtain warp-free fabrics.

Acknowledgment

The Engineering Experiment Station is indebted to the Exeter Manufacturing Company, Exeter, New Hampshire, and 40 Worth Street, New York, New York, for establishing an industrial fellowship under which this work was done, for furnishing all of the materials and for the aid contributed by their chief chemist, Mr. Norman S. Cassell. The resins used in these experiments were supplied by the Bakelite Corporation, whose courtesy is greatly appreciated.

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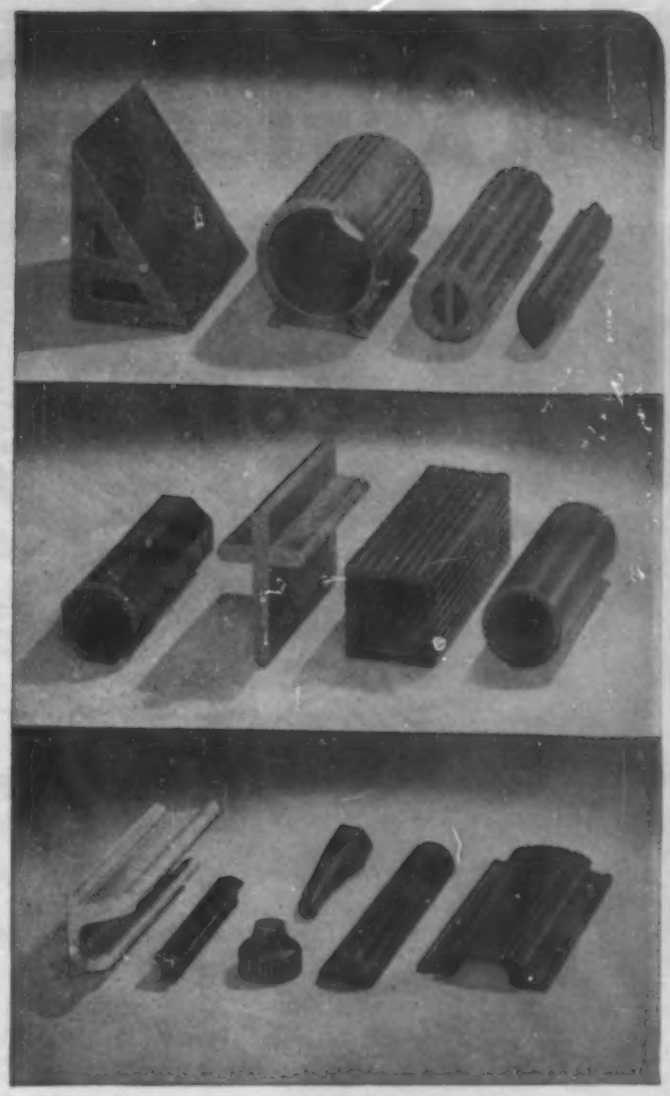

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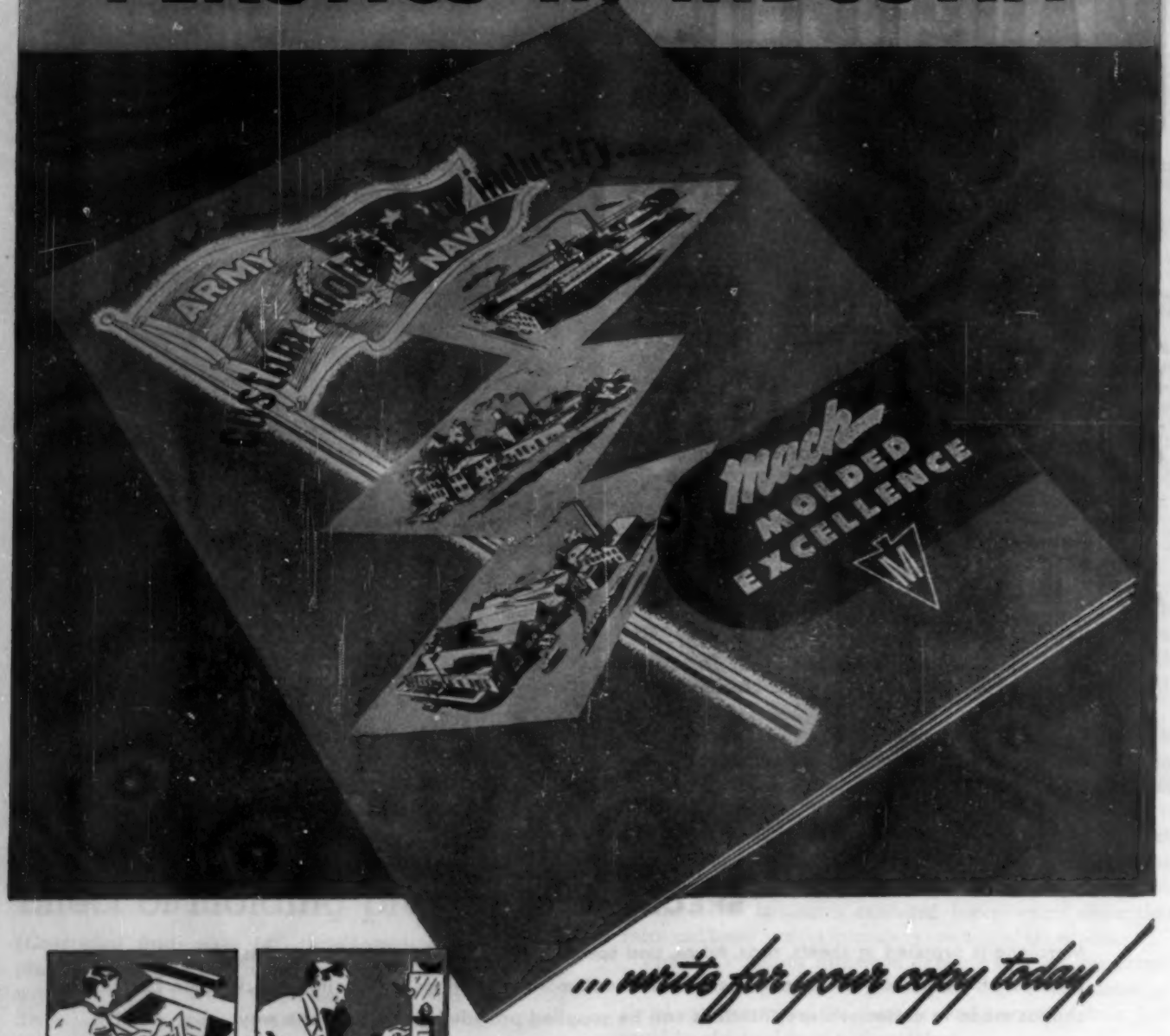

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It is the purpose of MACK MOLDING to promote—intelligently—the wide use of these materials, rather than promiscuous specification without regard for adaptability. You will find your copy helpful. Write today Mack Molding Company, Inc., 120 Main Street, Wayne, New Jersey.

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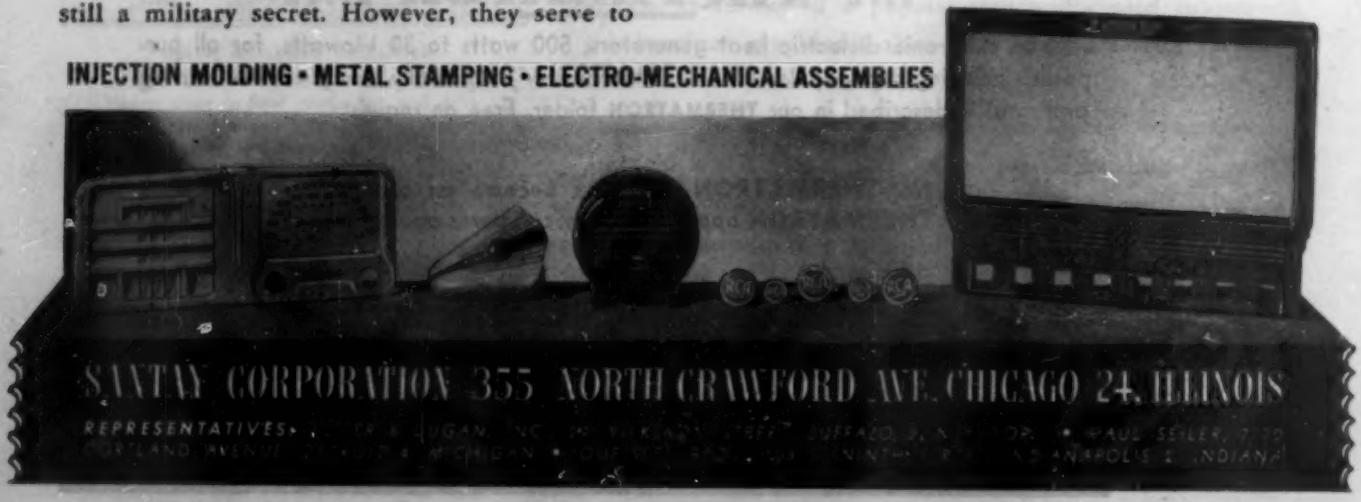

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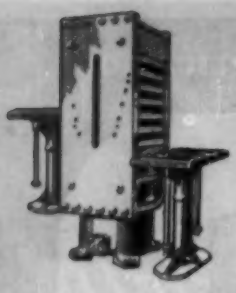

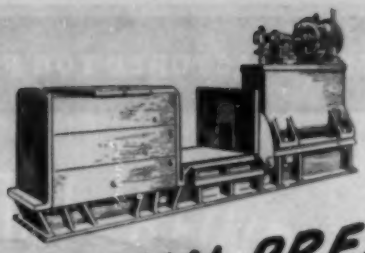

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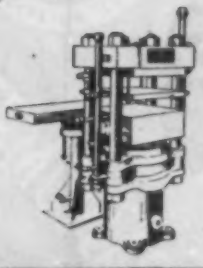

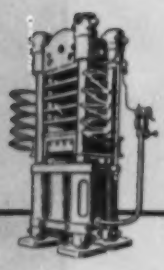

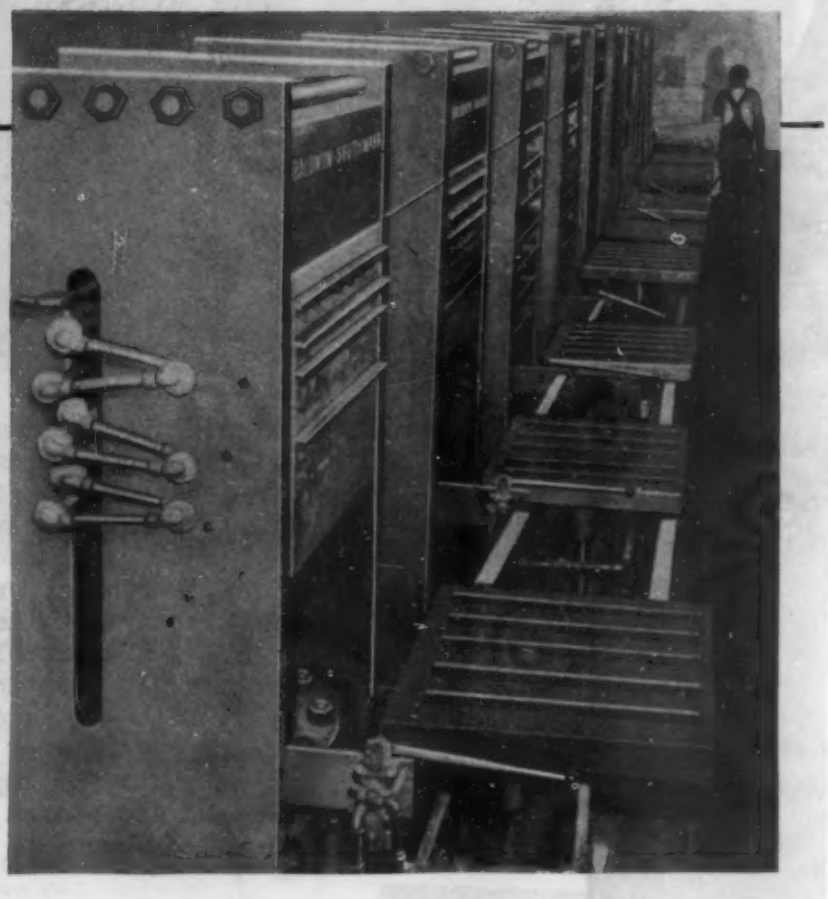

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BULLETIN 23

Plastics Bulletin 23 (recently announced) has been withheld in order to include a vitally important addition to the Olsen line of Plastics Testing Equipment. If you have requested a copy and have not received it, we ask your forbearance. If not, write today to reserve your copy which will appear in the very near future.

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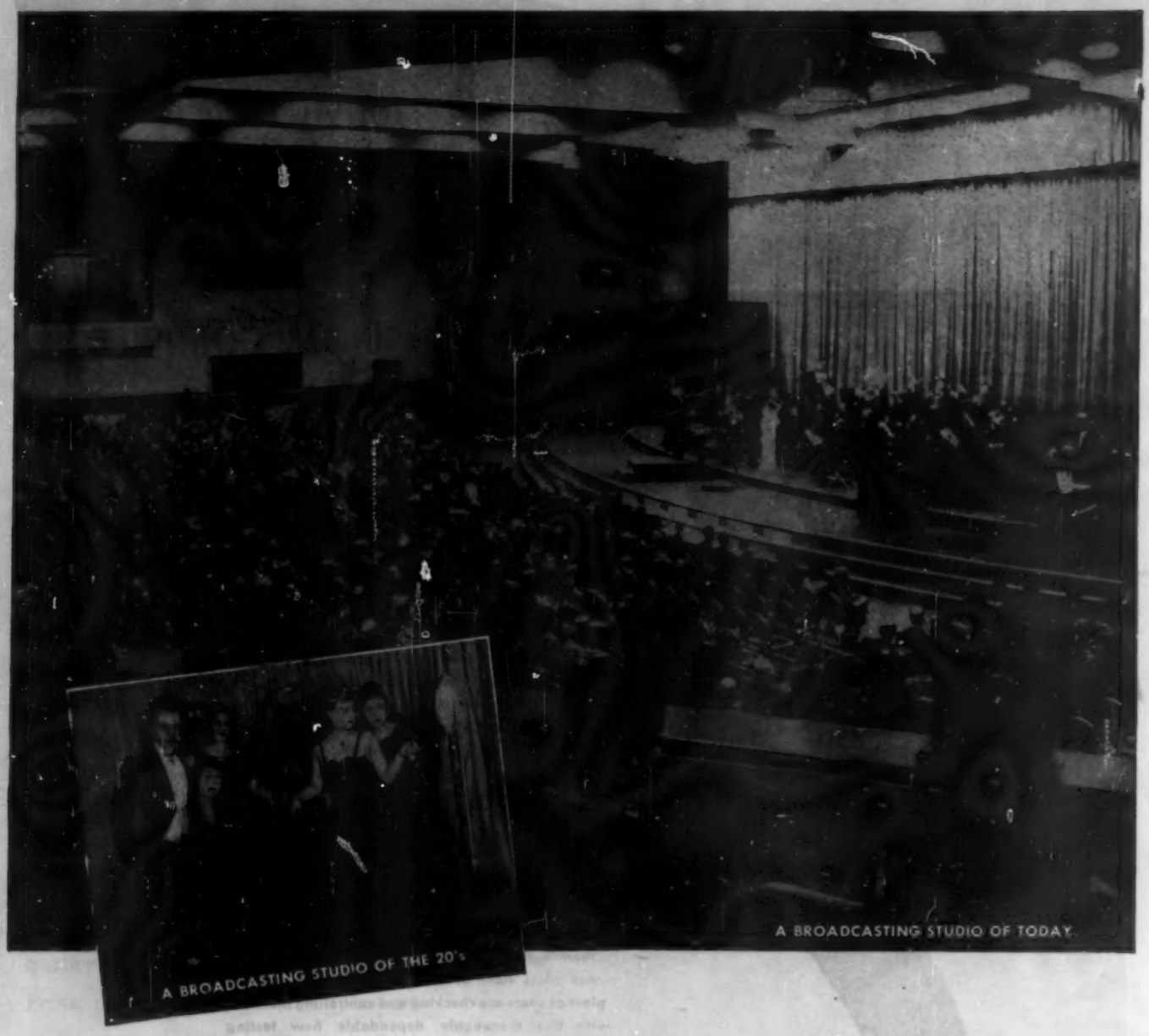

Echoes of a Quarter Century

During the years from 1920 to 1945 radio has grown from an infant to a huge industry serving and influencing the lives of millions, and is now reaching into new fields through television and radar.

A similar growth has occurred in the chemical industry in America during these years. Founded in 1920, Witco has grown steadily with this industry, playing an increasingly important role in the development of new and finer chemicals and better processing methods for the manufacture of various products. And during the war Witco's experience has been greatly enhanced by the development and adaptation of special materials to war demands. Particularly valuable are the company's contributions in the fields of rubber, sealing compounds, surface coatings, printing inks and asphalt products.

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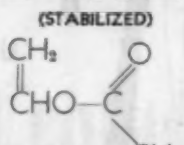

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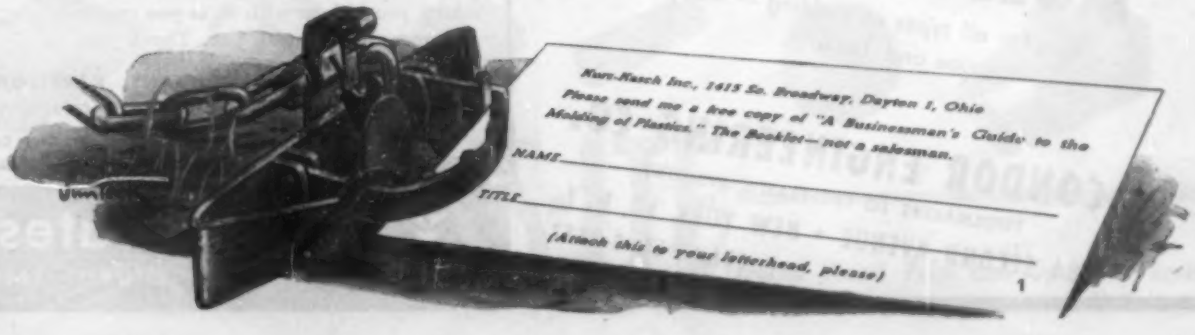
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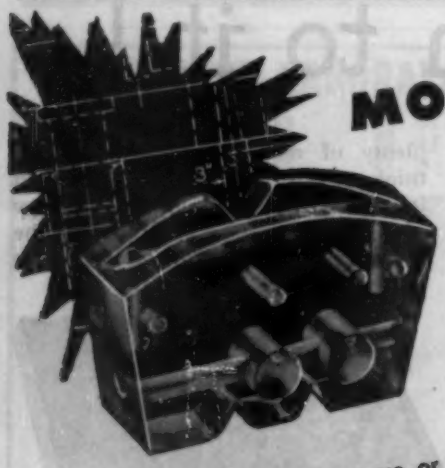

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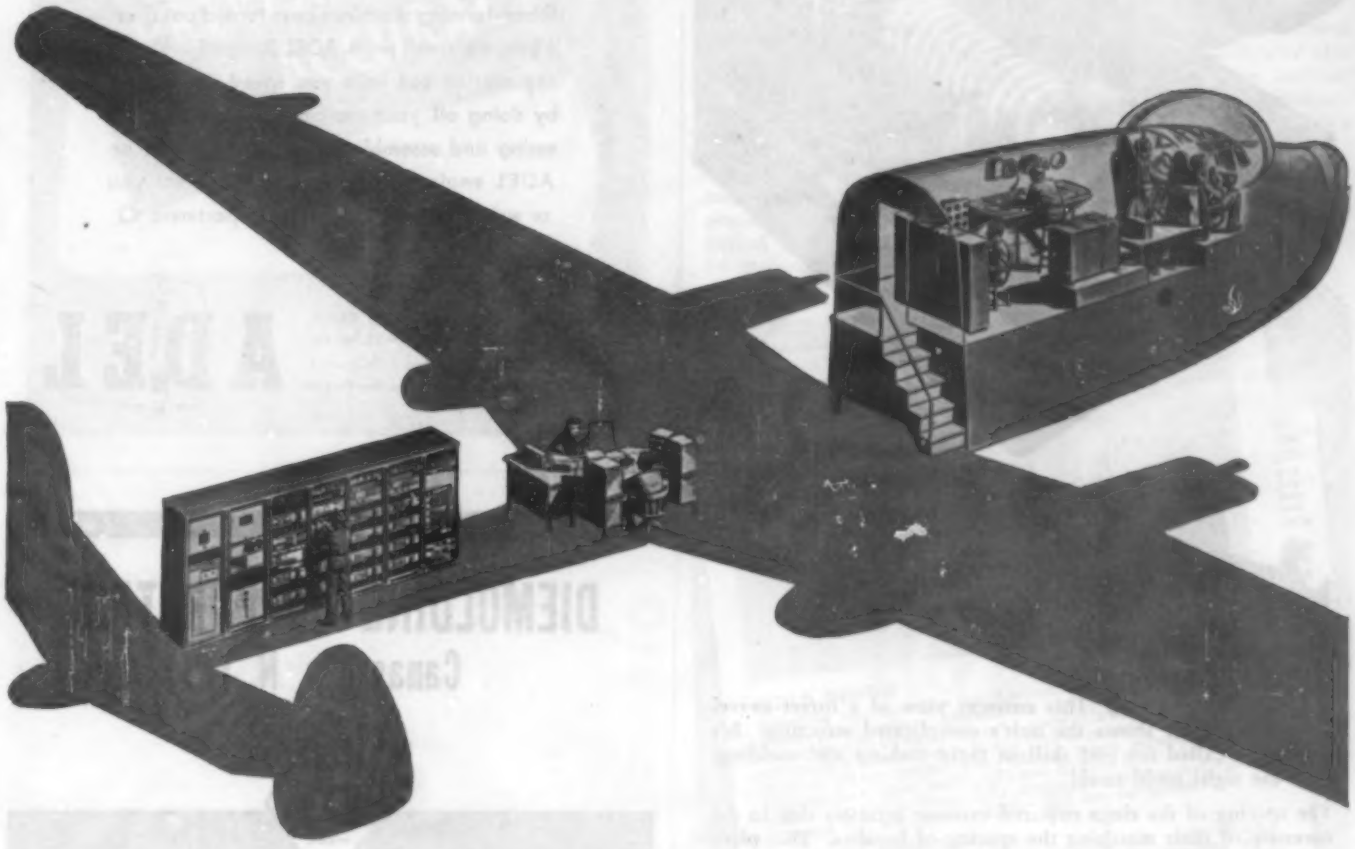
THIS SEA-GULL LIVES ON THE GROUND



This is a "flight trainer"— an electronically operated replica of the PBM-3 flying boat. It was conceived by the Bureau of Aeronautics and developed by Bell Telephone Laboratories to train Navy bomber crews on the ground.

The new crew climb a few steps to get in and from then on it is like being in a big plane at night. Controls tug against the pilot's grasp and "engines" roar in response to the throttle. From his desk, the instructor creates every situation of real flight — even to iced-up wings, conked-out engines and sudden air-pockets. The novice pilot and his crew get the feel of danger without the hazard.

Once the control dials are set, the various effects are automatically organized and set in motion by concealed machinery which includes 200 vacuum tubes, 60 motors, loudspeakers and hundreds of associated parts. Twenty Laboratories engineers worked more than a year developing the project. Drawings covered an area equal to 15,000 square feet.

This is only one of the 1200 projects in which our experience has been able to help the Armed Forces. What we have learned in devising electronic circuits to train flyers will help build better telephones.

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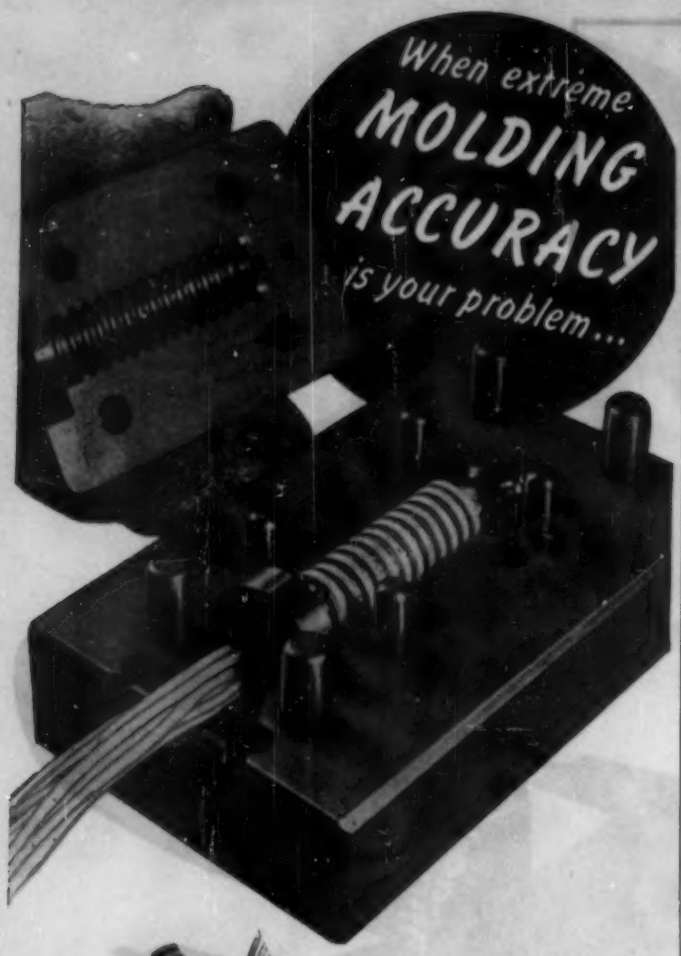

Cutaway of turret swivel joint for aircraft, molded by Plastic Manufacturers, Inc. Mold made of Carpenter Stentor Mold Steel.

● This cutaway view of a turret swivel joint for aircraft shows the unit's complicated structure. It's a job that called for real skill in mold making and molding. Plus the right mold steel!

The spacing of the rings required extreme accuracy due to the necessity of their matching the spacing of brushes. This piece had to be held to a close diameter and kept straight so that warpage during hardening would be held to a minimum. A flat parting line between splits had to be maintained to eliminate excess flashing of the mold. Thus, Carpenter *Stentor* Mold Steel was indicated for the job.

On your jobs where extreme hardening accuracy, maximum strength or corrosion resistance is required of molds, take advantage of Carpenter's experience with mold steels. And if you don't already have a copy, ask your nearby Carpenter representative for "Tooling Up for Plastics." Or a note on your company letterhead will start this useful 36-page book on its way.

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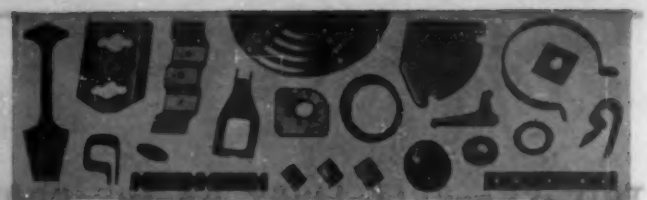

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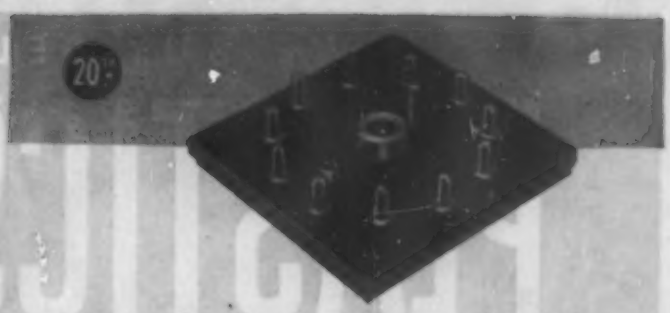

Tap Switch Plate Makes "GOOD CONNECTIONS"

HERE'S an electrical part that has made "good connections"... with plastics... and with Aico.

This tap switch plate... used in X-ray equipment... is molded from plastics for extreme accuracy and dimensional stability over a long period of service. It contains 14 molded-in brass and steel inserts for providing electrical contacts and for assembly with other parts. This is another difficult molding job, successfully engineered by Aico's plastic experts.

At Aico, high skills and experience gained in 29 years of precision molding are "on tap" for the solution to all types of plastics problems.

BAKELITE 1132 TAP SWITCH PLATE

Tap Switch Plate Molded from Bakelite 1132

MOLD DESIGN
Exacting requirements for this tap switch plate demanded expert mold making. Dimensions from base (A) of threaded terminals (B) to flat surface of plate (C) must be extremely accurate. Circular brass insert (D) is partially imbedded in molded plate; tapped part (E) of insert extends through molded part. Steel inserts (F) and (G) are flush with contact side of plate (C). Bosses (H), alternating with metal contact buttons (J), are plastic. Holes (K) are for assembly.

MOLDING METHOD
The transfer method, used in molding this part, offers a paramount advantage in its suitability for molding parts with numerous inserts. The inserts can be held in place more accurately than in compression molding because the mold is closed when material enters. Minimum flash is produced by this method, thereby cutting finishing time on parts which require removal of all flash from inserts.

MOLDING MATERIAL
The molded plate must be perfectly flat because of electrical contacts. Proper wall thickness had to be determined to provide the fastest possible cure and, at the same time, provide sufficient anchorage for inserts. Bakelite 1132 provided the chemical and physical properties required. This material has good dimensional stability, is suitable for molding inserts and has a good surface finish.

**This is No. 20 in Aico's plastics applications series. Send a request on your letterhead for file cards Nos. 1 to 20.*

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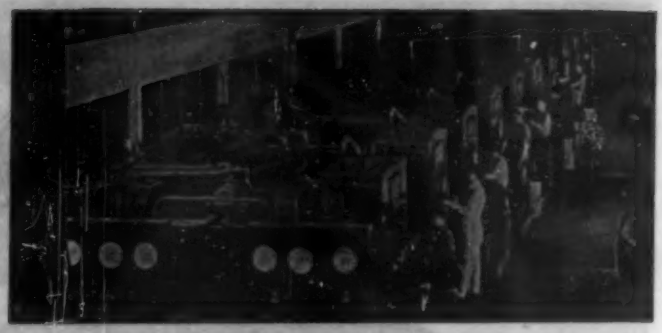

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Branch of the Industry	Name of Appliance	Use
Molders (Thermo-setting) Compression	PELLET-VEYOR (Variable heat)	To preheat pellets and preforms at the press as needed
Molders (Thermo-plastic) Injection	VIBRA-VEYOR (Variable heat)	To preheat plastic powder automatically. To dry plastic powder automatically
Injection	HOPPER-HEATER (Variable heat)	To warm up heavy metal of hopper of molding machine
Molders (Thermo-plastic) Extrusion	STRIP-HEATER (Variable heat)	To preheat strip rolls of vinylite, etc., automatically as fed to worm
Material Manufacturers	Special production equipment including vibrators, conveyors, stainless steel belts and electronic devices	To process various kinds of plastic material in bulk
Fabricators (Miscellaneous)	BENCH-KIT In various sizes (Variable heat)	To soften sheets, rods, tubes and any shape for bending, forming, punching, etc. This includes Cellulose, Acetate, Methyl Methacrylate

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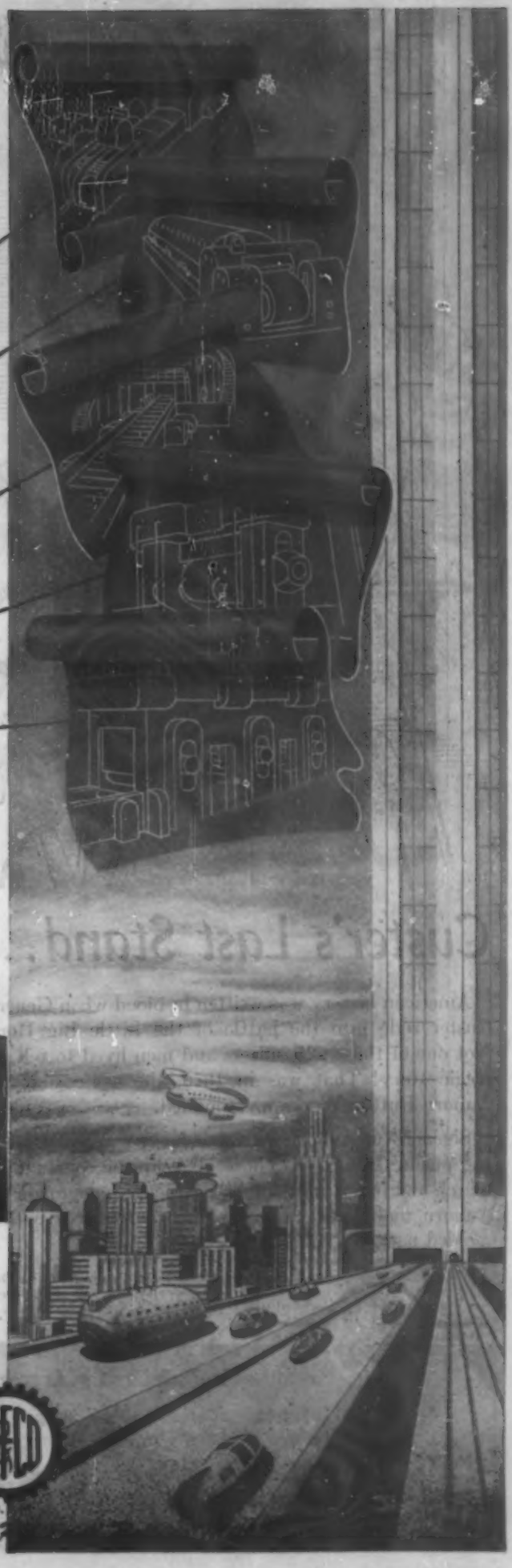

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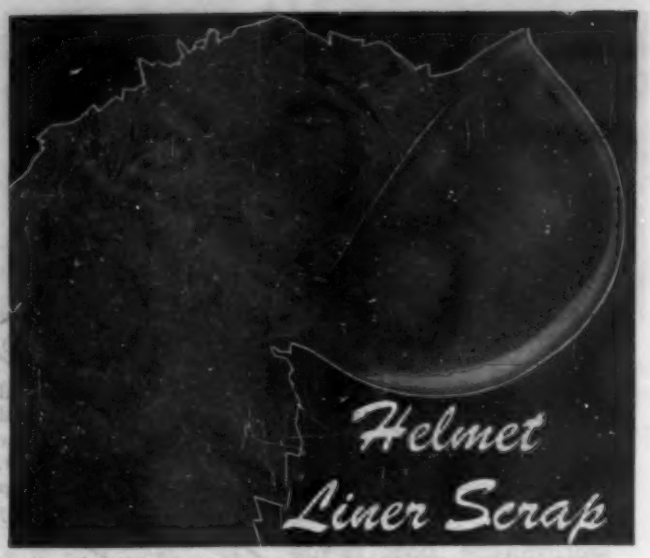

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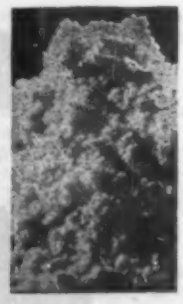

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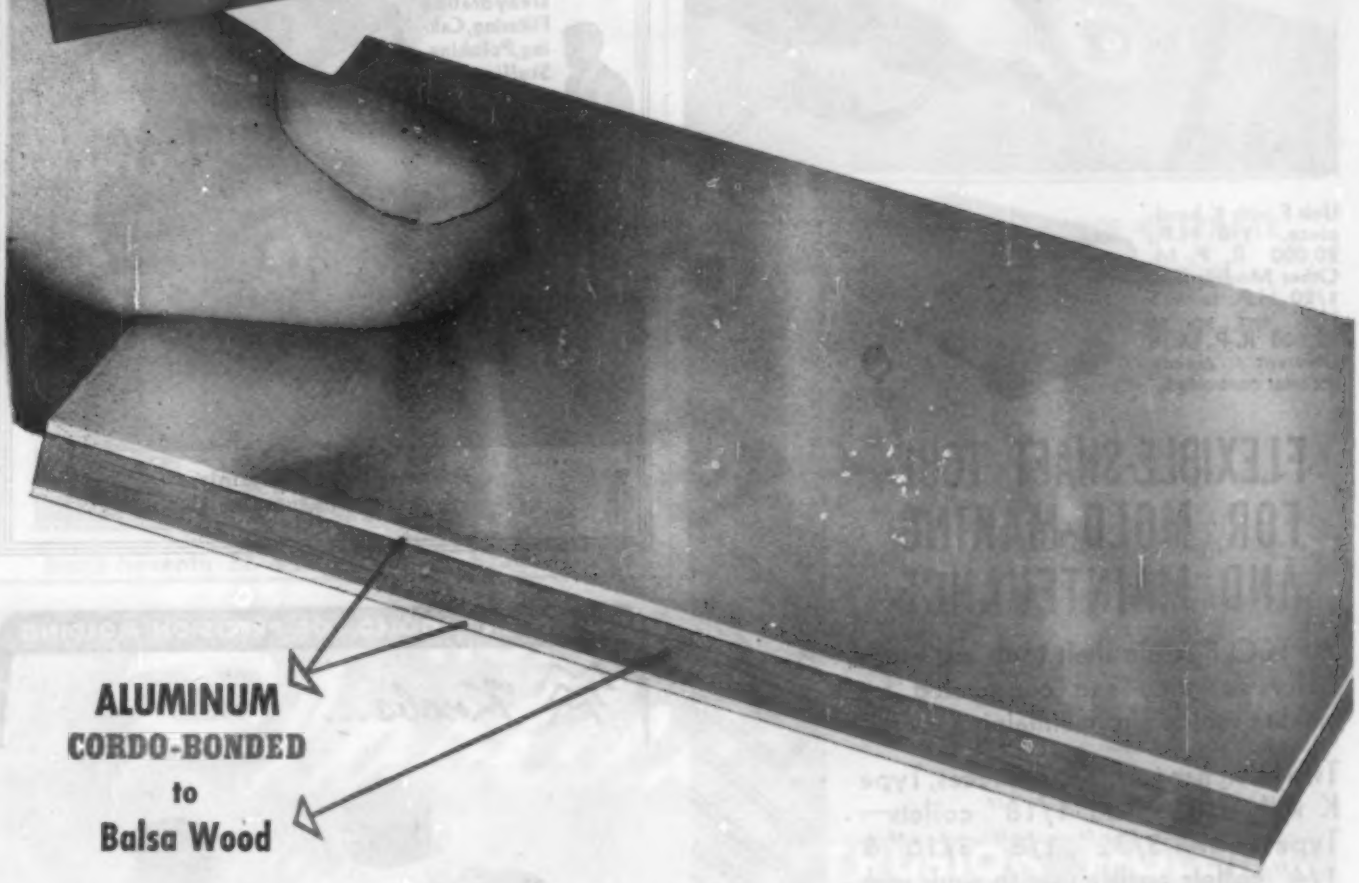

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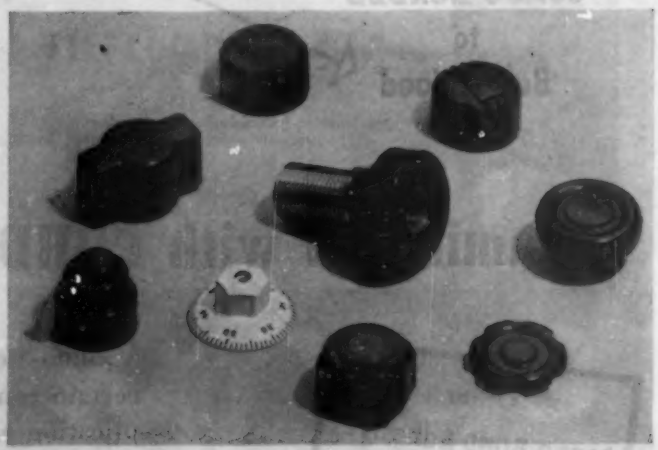

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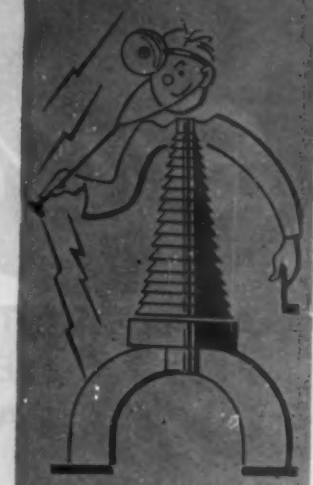

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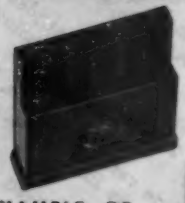

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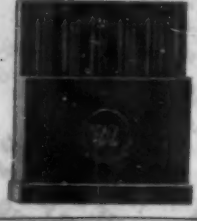

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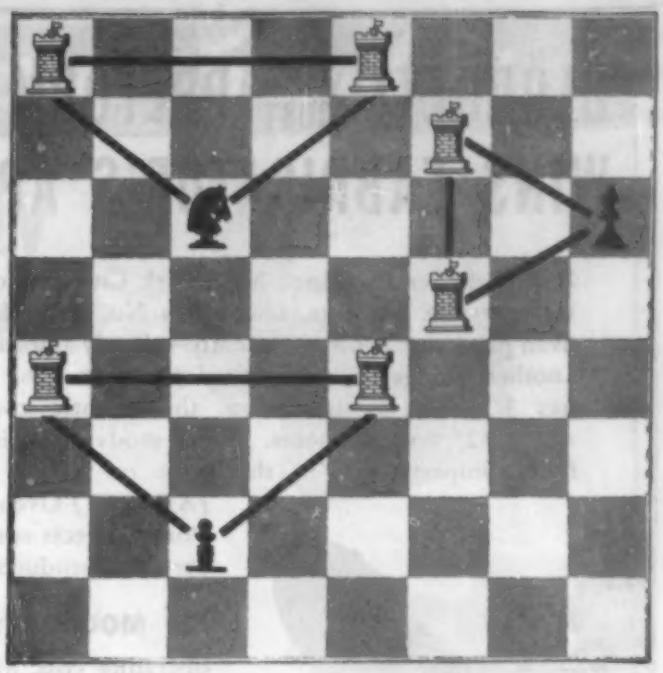

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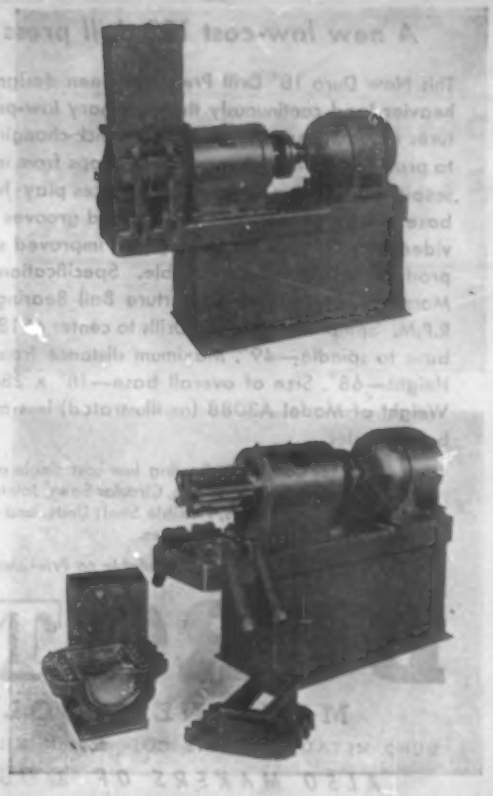

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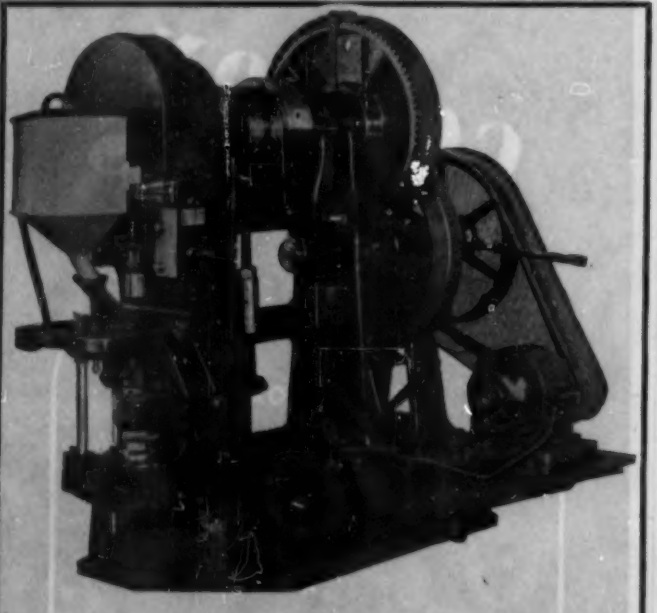

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A PLASTIC ANSWER

TO YOUR PROBLEM

The secret of success in plastics is in knowing the right plastic to use for the job at hand. Many items are practical to make in plastics for those who have the "know how." ● Your work at Magnetic Plastics is custom moulded from plastics best suited for the job. ● Ask us to help you see what plastics can do in your business. Just send photo, sample or specifications, and we'll tell you quickly if it can be made in moulded plastics.

THE MAGNETIC PLASTICS CO.
1900 EUCLID BLDG. • CLEVELAND 15, OHIO

PLASTIC MOLDS

25 years experience in designing and building molds for leading molders.

Our plant is modern in equipment for producing the best in molds. Compression, Injection, Transfer.

SOCIETY OF THE PLASTICS INDUSTRY

FORTNEY MFG. CO.
247 N.J. R.R. Ave.
NEWARK 5, N. J.

RIGHT DIRECTION

IN USE OF *Plastics*

For better planned plastics in your present or future product - - *KNOW NOSCO NOW.* When planning your use of plastics, avail yourself of NOSCO'S long experience in designing, engineering and molding. In NOSCO'S modern plant you can count on the *RIGHT DIRECTION* of all factors to make plastic products with distinction. Write today giving your requirements - - no obligation of course.

NOSCO Plastics

DIVISION OF NATIONAL ORGAN SUPPLY CO., ERIE, PA.

Materials

PROCESSING EQUIPMENT

Sifters, Crushers, Cutters, Dry and Liquid Mixers, Mills, Grinders, Pulverizers, Conveyor Systems, Complete Installations.

The handling equipment construction "know-how" of the Mercer Engineering Works, Inc., Clifton, N. J. . . . The more than 40 years processing equipment experience of Robinson Mfg. Co., Muncy, Pa. . . . All are embodied in and represented by

MERCER-ROBINSON, CO., INC.
30 CHURCH ST., NEW YORK 7, N. Y.

Materials

HANDLING EQUIPMENT

Trailer Trucks (All Types) Wheel Tractor Cranes (3 to 7 ton) Fork Lift Trucks, Lift Platforms, Hoists, Live Skids, Wheels, Casters.

Decals

APPLIED IN YOUR OWN PLANT!

No Machinery or Equipment required for Plastics Decoration

More and more plastics manufacturers are turning to decals to answer their marking, decorating and identifying problems. Decals are simply applied by unskilled labor right in your own plant. Can be applied to phenolics, ureas, vinyls, acetate, butyrate, etc., etc. The decals come to you made to your design (or we'll create a design for you) in the colors you prefer, ready for application. There is no simpler or more economical method of surface decoration. Perfect for stock mold items.

Write for samples, prices.

PALM, FECHTELER & CO.
220 W. 42nd St., New York 18, N. Y.
21 E. Van Buren St., Chicago 5, Ill.

JUST OFF THE PRESS!

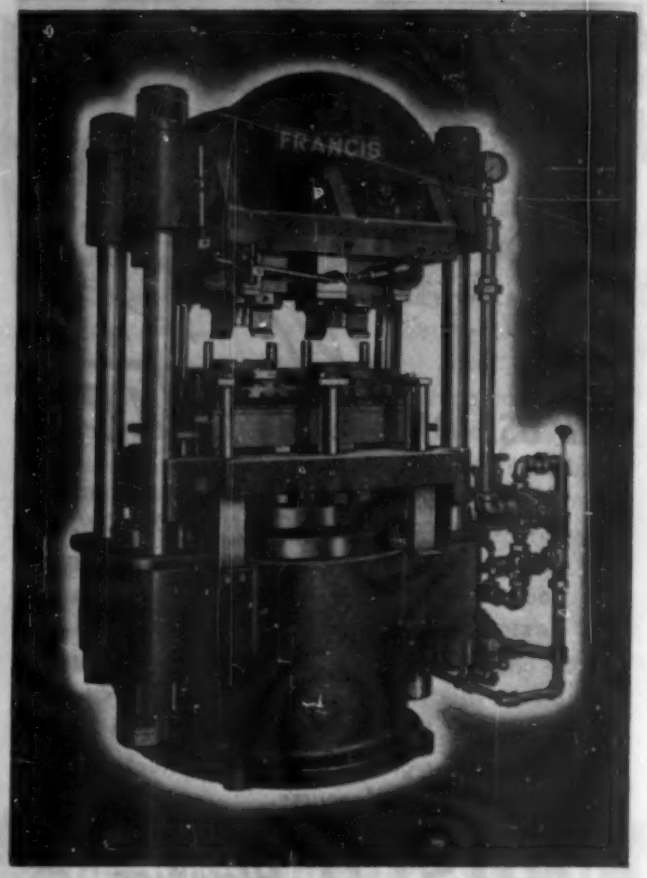
SEND TODAY FOR YOUR COPY of this specially prepared, illustrated industrial finishing catalog. Describes McAleer's complete line of Quality-Controlled Polishing, Buffing and Deburring compositions. Also contains valuable reference data on finishing PLASTICS, non-metals and metals. Fill in and mail coupon now.

SEND FOR YOUR COPY TODAY!

McAleer Manufacturing Company
Dept. K, Industrial Finishing Div., Rochester, Mich.
Gentlemen: Please send me as soon as possible a copy of your new Industrial Finishing Catalog.

Name_____
Position or title_____
Company_____
Address_____
City_____ **Zone**___ **State**_____

McAleer MANUFACTURING CO.
Quality-Controlled Finishing Materials
ROCHESTER, MICH.
PLASTICS FINISHING DIVISION ★ ★ ★
McALEER MANUFACTURING CO., CHATHAM, ONT.



Francis EST. 1880. HYDRAULIC PRESSES

- *FOR PLASTIC, RUBBER, ETC.*
- *LABORATORY OR PRODUCTION JODS*

Here are just a few of the plastic moulded products produced on the production line by Francis Hydraulic presses. Francis Presses are available in a wide range of sizes and models making them ideally suited for laboratory use or large production jobs of plastic, rubber, compreg wood and many other products. Get complete details on Francis line of Presses . . .

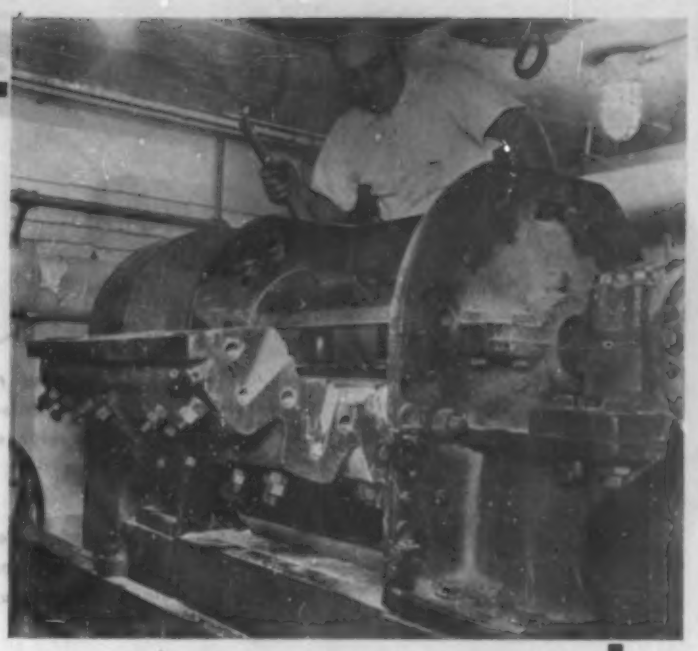
Write or Wire today

The Hosdreg Industries Incorporated
HUNTINGTON, INDIANA

BALL & JEWELL GRANULATOR IN PLASTIC MATERIAL PLANT

Here is an excellent view of a Ball & Jewell machine showing the solid construction and the inner quality which makes Ball & Jewell equipment outstanding for granulating both new and scrap material. This is a photograph of a #2 machine installed in the plant of one of the largest material manufacturers in the country. Note the tremendous heavy castings, the solid tool steel knives, the removable screen for controlled sized granulations. And, note the ease in which this heavy piece of equipment can be taken down for cleaning. One man and a wrench are all that are needed.

This installation is noteworthy for its feeding system. Material comes through a hopper from the floor above directly into the machine.



This is #8 in a series of advertisements showing typical installations of Ball & Jewell equipment.

BALL *and* JEWELL

20 Franklin Street, BROOKLYN, N. Y. Since 1895, Manufacturers of Patent Rotary Cutters

or get in touch with nearest representative

CHICAGO: Neff Kohlbusch & Bissel. DETROIT: J. C. Autterberry's Sons. LOS ANGELES: Moore Machinery Co. LOS ANGELES & SAN FRANCISCO: Machinery Sales Co. NEW ENGLAND: Standard Tool Co., Leominster, Mass. ATLANTA, GA.: George L. Berry. ST. LOUIS: Lanmore Sales Co. SEATTLE 4, WASHINGTON: Olympic Supply Co. KANSAS CITY, KANS.: Fluid Air Engineering Co. AUSTRALIA and NEW ZEALAND: Scott & Holladay Pty., Ltd., SYDNEY STOCKHOLM, SWEDEN: Ingenjorsfirman Teknova. CANADIAN AGENTS: Williams & Wilson, Ltd., Toronto & Montreal, Canada HAWAIIAN ISLANDS: Hawaiian Sales Service, P. O. Box 3498, Honolulu 11, T. H.

New England Screw Co.

KEENE, NEW HAMPSHIRE

50 YEARS OF SPECIALIZED EXPERIENCE

MACHINE SCREWS — PLASTIC INSETS
SHEET METAL SCREWS — HOLDING PINS
MACHINE SCREW NUTS — SPECIAL RIVETS
ALL TYPES OF HEADS AND THREADS

Wherever there's a high pressure to be reduced there should be an

ATLAS Type "E"

High Pressure Reducing Valve

There are many types and sizes of ATLAS Reducing Valves. We make them for every service. For high pressures such as are commonly employed in plastics plants—up to and including 6000 lb. per sq. in.—we usually recommend the reducing valve shown at the left. It operates *without shock*—oil, water, or air—and we know it is giving satisfactory service because we receive orders for more nearly every day.

What Is Unusual About It?

Every detail is modern in every respect. Thus, for example, the entire body is of forged steel. The internal metal parts are entirely of stainless steel. A formed packing of special material superior to leather is used which is immune to all fluids commonly used in hydraulic machinery. The pressure on the seat is balanced by a piston with the result that variations in high initial pressure have little effect on the reduced pressure.

Ask for complete information.

For other ATLAS plastics plant products see the partial list in our ad in the January 1945 issue of MODERN PLASTICS

ATLAS VALVE COMPANY

REGULATING VALVES FOR EVERY SERVICE

277 South Street, Newark 5, N. J.

Representatives in principal Cities

thermoplastics scrap BOUGHT

reconditioned molding powder SOLD

SELL US YOUR THERMOPLASTIC WASTE. Sell us rejected molded pieces or obsolete molding powders—cellulose acetate, cellulose aceto-butyrate, polystyrene, methyl methacrylate, or polyvinyl resin.

WE SEPARATE ALL CONTAMINATIONS, removing steel or other mixtures—metal or anything else—and rework and plasticize the material into first class, ready-to-use reprocessed molding powder.

BUY FROM US when reconditioned molding powder is needed for your process. You'll find our product a trustworthy and reliable element. Contact us at our modern plant. Inquiries will receive prompt attention.

A. BAMBERGER
plastic
materials

Call or Write

Department M.
44 Howes St., Brooklyn 11, N. Y.
Evergreen 7-3887
Cable: Chemprod

NO WONDER THEY'RE POPULAR

5 GOOD REASONS

- LOW FIRST COST
- SIMPLE TO "SET UP"
- LOW UPKEEP COST
- EASY TO OPERATE
- SMALL FLOOR SPACE

There are many reasons why Famco Foot Presses are popular. They are the inexpensive solution to light forming, stamping and punching jobs. They offer mass production speed without power cost. They are easily operated by women or girls. Famco Foot Presses are ruggedly built in 10 models, for bench and floor mounting. Let Famco engineers help select the proper machines. Write today for catalog.

POWERFUL PRESSES THAT NEED NO POWER

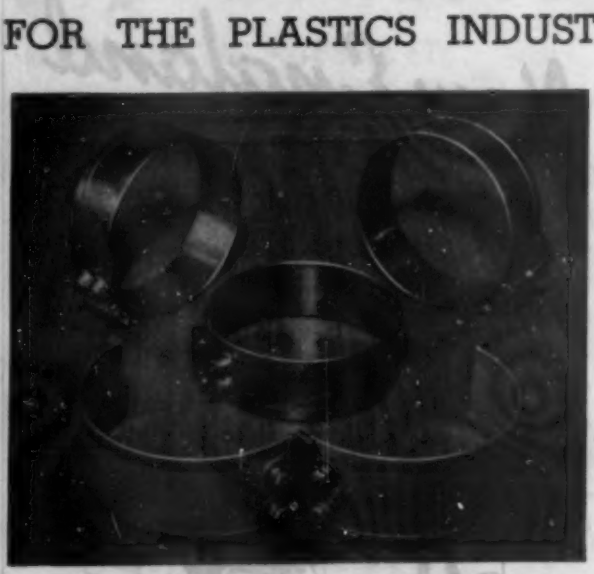
Famco Arbor Presses, in 32 models, bench and floor mounting, will deliver up to 15 tons pressure . . . require no electric power.

Famco Foot Powered Squaring Shears, in five sizes (cutting widths, 22" to 52") will cut up to 18 gauge mild steel.

FAMCO MACHINE CO., 1305 18th ST., RACINE, WISCONSIN

famco ARBOR PRESSES
FOOT PRESSES
SQUARING SHEARS

ELECTRIC HEATING EQUIPMENT
FOR THE PLASTICS INDUSTRY



HINGED TYPE BAND UNITS (illustrated) for all injection moulding machines; Size and Wattage to your specifications. Also space, strip, cartridge and immersion heaters—for the industry. We manufacture hot plates and ovens as well. Send us your heating problems.

GLENN ELECTRIC HEATER CO.
239-241 Canal Street New York 13, N. Y.

Experience is the Answer to Plastic Problems

The molded plastic business cannot be learned over night as some people seem to believe.

In fact, the knowledge of properly molding each of the many different plastic materials requires years of actual experience. Each characteristic requires special handling learned from scientific research and actual production.

Because our organization is built around men of long experience we are able to obtain the finest results from any of the following materials:

Bakelite	Lumarith	Resinox
Durez	Lucite	Saran
Ethocel	Plaskon	Tenite

CUSTOM MOLDING

M

EXTRUSION
INJECTION
COMPRESSION

MICHIGAN MOLDED PLASTICS, Inc.

Dexter, Michigan

MOLDED TERMINAL STRIPS

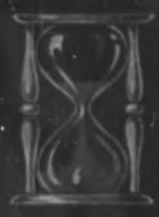
COMPLETELY ASSEMBLED

WITH HARDWARE

Available in lengths from 1 to 20 terminals.
2 Types: NAS 17 and NAS 18. Prompt deliveries.

Northern Industrial Chemical Company

7-11 ELKINS ST., SO. BOSTON 27, MASS.
34 YEARS OF PLASTIC MOLDING EXPERIENCE



We could go on for HOURS...

telling you about the background and wide experience of Continental Plastics Corporation—about plastic engineers and our fine plastic facilities both for designing and molding plastics—about our wide experience in turning out intricate plastic designs and molded products.

BUT we prefer to let our craftsmanship and reputation speak for itself.

One experience, we believe, will convince you of the advisability of putting your plastic problems and plans into the competent hands of Continental—today's experts in plastic custom injection molding.

NOW is the time to send or bring in your blueprints or sample product. Or, ask for a representative to call.

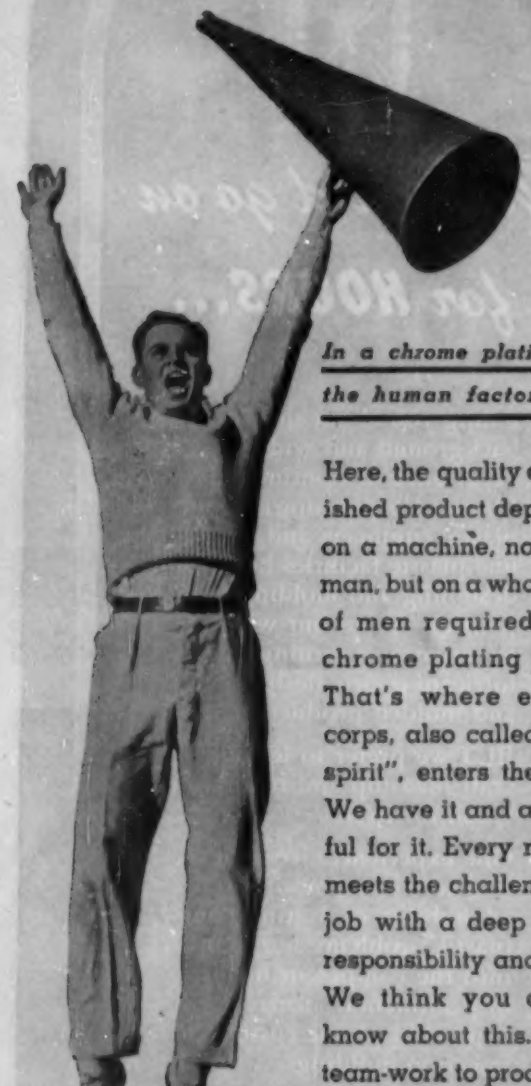
cpc

CONTINENTAL

PLASTICS CORPORATION

308 WEST ERIE STREET
CHICAGO 10, ILL.

IT'S ALSO CALLED "school spirit"



In a chrome plating plant, the human factor is high

Here, the quality of the finished product depends not on a machine, nor on one man, but on a whole group of men required for the chrome plating process. That's where esprit de corps, also called "school spirit", enters the picture. We have it and are thankful for it. Every man here meets the challenge of his job with a deep sense of responsibility and loyalty. We think you ought to know about this. It takes team-work to produce consistently good chrome plating. We can offer it to you.

KEEP UP-TO-DATE WITH HARTFORD CHROME

***Free* "Show-How Literature"**

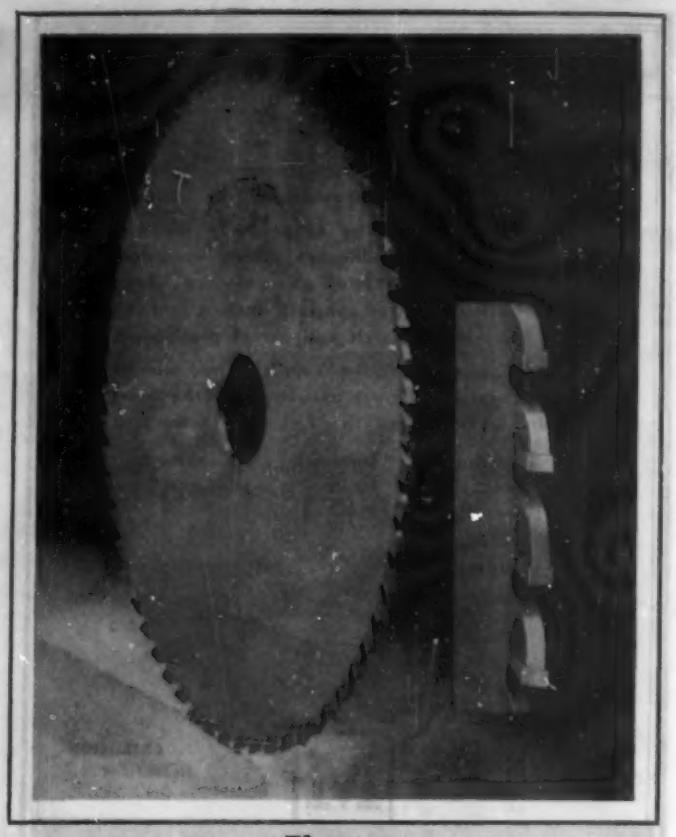
FREE BOOKLET for postwar planners, entitled "After V-J Day, How Will You Use Chrome Plating?" Write for it.

HARTFORD CHROME CORP.

525 PARK STREET • HARTFORD 6, CONNECTICUT • TEL. 2-6848

WE SERVE NEW ENGLAND, NEW YORK AND NEW JERSEY

Licensed by United Chromium Inc.



These SIMONDS CIRCULAR SAWS have teeth tipped with Tungsten Carbide

...TO CUT MORE PLASTIC and run longer between sharpenings

Carboloy cutting points, brazed onto the teeth, enable these Simonds Saws to give exceptionally smooth cutting and long service life on practically any type of plastic except thin-walled stock. For smooth cuts the tips are flush with the concave-ground sides of the teeth. But for heavy cutting not requiring smooth finish, the teeth are set alternately left and right. These saws are made on order.

Other types of Simonds Plastic-Cutting Circular Saws are the High-Speed, Steel, Semi-High Speed Steel, Special Alloy Steel, and Simonds patented T-11 Steel which is especially recommended on softer plastics because of its self-lubricating property that minimizes adherence of material to the saw. Consult our nearest office.

SEND FOR FREE BOOK... *tells how to cut any type of plastic* . . . also tells how to determine saw specifications and how to get best results from Simonds Circular Saws. Write for a copy.

BRANCH OFFICES: 1350 Columbia Road, Boston 27, Mass.; 127 S. Green St., Chicago 7, Ill.; 228 First St., San Francisco 5, Calif.; 311 S. W. First Ave., Portland 4, Ore.; 31 W. Trent Ave., Spokane 8, Wash.; 416 W. 8th St., Los Angeles 14, Calif.

SIMONDS SAW AND STEEL CO.

FITCHBURG, MASSACHUSETTS

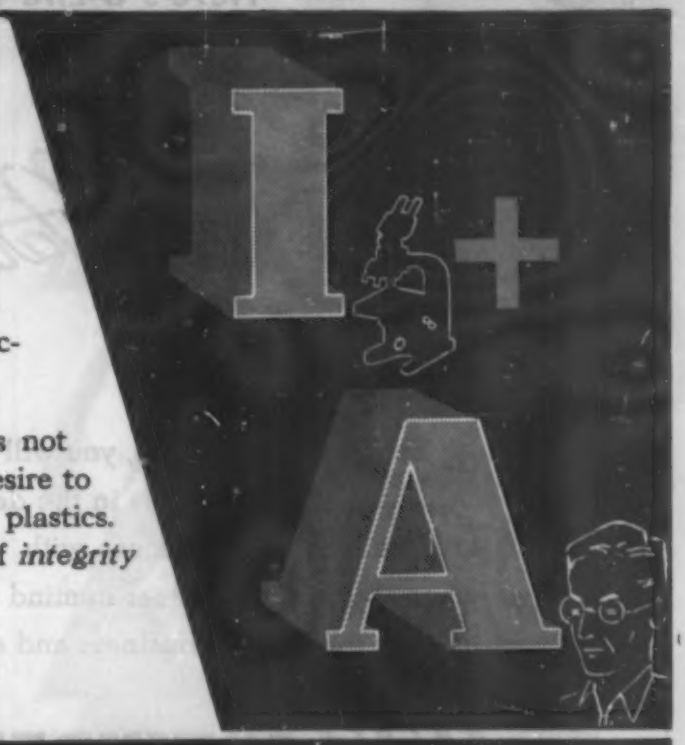
HAPPY COMBINATION

- Integrity
- Ability

THOSE WHO HAVE COME TO KNOW IDEAL PLASTICS, have learned to rely upón our background of promises kept and assignments successfully completed.

OF COURSE, THE *DESIRE* TO DO A JOB WELL is not enough. Here, at Ideal, we combine a sincere desire to excel with unusual ability and understanding of plastics. Here, at Ideal, we offer a happy combination of *integrity* and *ability!*

Ideal



IDEAL PLASTICS CORPORATION
A DIVISION OF IDEAL NOVELTY & TOY CO., INC.
23-10 43rd AVE., LONG ISLAND CITY, N. Y.

Remove Moisture from PLASTICS

Quickly and Cheaply with NALCO *Infra-Red* LAMPS

Do you know . . . all of the advantages of Infra-Red Ray Drying with Nalco Dritherm Carbon Filament Lamps?

Use Nalco Ditherm Lamps for efficient results . . . available in Inside-Silvered (self-reflecting) or clear glass types.

Learn all of the advantages of the Infra-Red process for plastic dehydration.

Write for your free copy of "Drying Problems Made Easy" today.

Exterior of Infra-Red Conveyor Belt Tunnel for removing moisture from plastic material prior to molding.

Sides dropped to show arrangement of Infra-Red light bank and materials passing under light conveyor belt.

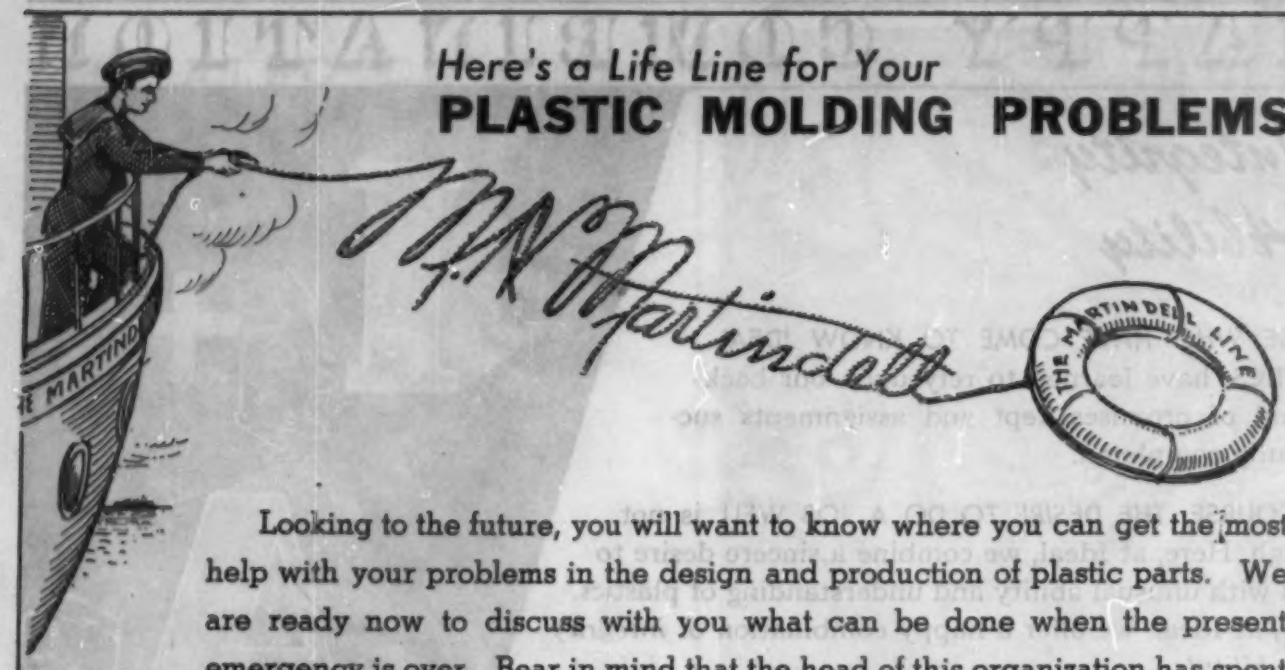
North American Electric Lamp Co.
1012 Tyler Street St. Louis 6, Missouri

NALCO

COTTON DUCKS
for
Laminators and Molders

Our Southern mills have made high-tensile cotton fabrics for the Plastics industry for fifteen years and specialty industrial cotton textiles for over thirty-five years. Our experienced development and production facilities are available to the Plastics trade, limited only by the requirements of our armed forces.

Curran & Barry
320 BROADWAY NEW YORK CITY



Here's a Life Line for Your

PLASTIC MOLDING PROBLEMS

Looking to the future, you will want to know where you can get the most help with your problems in the design and production of plastic parts. We are ready now to discuss with you what can be done when the present emergency is over. Bear in mind that the head of this organization has spent his entire life in the business and art of Plastic Molding.

MARTINDELL MOLDING CO.

OLDEN and 6th Street • TRENTON, NEW JERSEY

SINCE 1918

PLASTIC MOLDS

HAND
AUTOMATIC
SEMI-AUTOMATIC
and EXTRUSION
to the
LATEST METHODS

Designers and builders of all types of PLASTIC MOLDS. Serving most of the leading molders of the country!

Our 1500-ton hydraulic Hobbing Press adds many advantages in obtaining lower mold costs.

Estimates on request.

EAGLE

TOOL & MACHINE CO.

37-39 Freeman St. Newark, N. J.

Phone: MARKET 3-1572
-1573

SARAN by NATIONAL

WEAVING A NEW FUTURE IN WEAR-RESISTING FABRICS

SARAN BY NATIONAL is a tough monofilament offering distinct advantages in numerous textile applications. Fabrics woven from these filaments wear indefinitely—know no end of hard usage. They resist dirt, grease, acids, perspiration. . . a damp cloth will wipe them clean and restore their colorful beauty. For draperies, upholstery, luggage, auto seats and numerous other woven products, SARAN BY NATIONAL opens vast new possibilities.

SARAN BY NATIONAL is extruded and spooled as a monofilament in size and color required for every particular purpose, and supplied to mills, braiders and other fabricators.

WE DO NO FABRICATING

Write us for detailed information.

NATIONAL PLASTIC PRODUCTS Company

ODENTON, MARYLAND

SERVING COSMETIC, DRUG TRADE and OTHER INDUSTRIES

Fabricators of **PLASTIC FILMS** VINYL • BUTYRAL CELLULOSE ACETATE for Wearing Apparel, Sporting Goods and Household Items

Fabricators of **BOXES CANNISTERS** in all forms and shapes for packaging purposes.

Laminators of ALL TYPES **PLASTICS** VINYL BUTYRAL CELLULOSE ACETATE

National TRANSPARENT PLASTICS CO.

1897 COLUMBUS AVE. • SPRINGFIELD 3, MASS.

Time for a Change

If you are tired of having your product shunted from one department to another because of too much red tape, then it is time for a change.

For 25 years we have been proud of the personalized service we have extended to our customers. Their gratification has been evidenced by consistent satisfaction with our performance of their compression molding.

KENILWORTH

PLASTICS MOLDING COMPANY

Division of Eureka Button Co. (Est. 1885)

KENILWORTH, NEW JERSEY

EEMCO Presses

FOR PLASTIC AND RUBBER MOLDING

EEMCO HYDRAULIC PRESSES for Rubber and Plastic Molding are built to meet to-day's requirements. They are made in sizes from the small 12"x 12" Laboratory Press to any size necessary to meet your needs. When desired pull back cylinders can be provided to separate molds or presses can be equipped with double knockouts for the ejection of molded pieces. Write, now, for folder describing EEMCO presses and additional details.

SEND FOR LATEST BULLETIN

REFINERS • TUBERS • EXTRUDERS
STRAINERS • MILLS • CALENDERS
HYDRAULIC PRESSES • WASHERS
• • • CRACKERS • • •

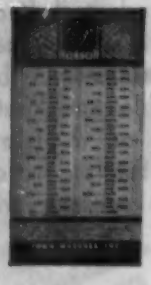
EEMCO

ERIE ENGINE & MFG. CO.

953 EAST 12th ST., ERIE, PENNA.

VERSATILITY...
special parts in any metal

The most efficient functioning of a special part in your product often depends upon the metal used. Our engineers will be glad to help you at no obligation on your part. We are equipped to cold-forge special parts in any metal, and in a wide variety of finishes. And costs for cold-forged parts are usually less.



This Decimal Equivalents wall chart is accurate to four places and signalled in three colors. Yours at no cost or obligation. Just send us your name, title and address.

See our Catalog in Sweet's File for Product Designers

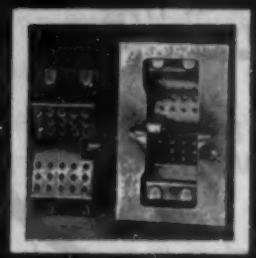
JOHN HASSALL, INC.
Specialists in Cold-Forging Since 1850
396 Oakland St., Brooklyn 22, N. Y.

SPECIAL NAILS RIVETS SCREWS
Hassall

here's how...
HOBBED CAVITY MOLDING

We're in the business of solving tough molding problems through hobbing. Many skeptical manufacturers have been convinced, by actual demonstration, of the economy, speed and accuracy of *hobbed cavity molding.*

If you have a problem, perhaps we can show you . . . "here's how"! Write today, to our engineering department.



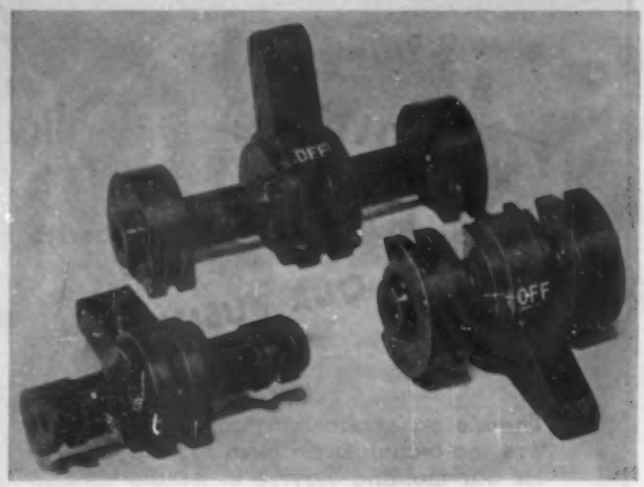
NEWARK DIE COMPANY, Inc.
20-24 SCOTT ST NEWARK, N. J.
Telephone – MARKET 2-3772, 2-3773

FILLERS

WOOD FLOUR
COTTON FLOCK
and FABRICS
OF SUPERIOR QUALITY
FOR THE
PLASTIC INDUSTRY

LARGEST DOMESTIC SUPPLIERS

BECKER, MOORE & CO., INC.
NORTH TONAWANDA, N. Y.



Your Future Molding Needs Can Be Met Here!

At present, of course, we are deeply involved with war orders, but when the "Rising Sun" has set for good, you will be glad to know that we have here at your service the best of equipment and skill for all types of molding.

Compression Molding — Injection Molding — Transfer Molding

From Design to Finished Piece

ESTABLISHED 1919 — TRADE MARK

KUHN & JACOB MOLDING & TOOL CO.

1200 SOUTHARD STREET, TRENTON 8, N. J.
TELEPHONE TRENTON 5391

Plastic Molding

Sales Representatives: NEW YORK—S. C. Ullmann, 55 W. 42nd St. PHILADELPHIA—Towle & Son Co., 18 W. Chelton Ave. Bldg.
NEW ENGLAND—Wm. T. Wyler, 204 Lordship Road, Stratford, Conn.

1855

Saturating Papers for PLASTICS

W.G.P. furnishes Sulphate or Cotton base saturating papers for the impregnation of thermoplastic and thermosetting types of resins in fluid form. We can also furnish light weight cotton paper to be used as a surfacing or print sheet. Manufacturers of leather substitutes in the luggage and shoe trades should investigate the unusual saturating qualities of our cotton sheet for the saturation of the various types of synthetic latex and resin emulsions.

Sample sheets and rolls available in various thicknesses.

WALKER · GOULARD · PLEHN · CO. PAPER AND BOARD
EXPORTS TO ALL PARTS OF THE WORLD

ORGANIC PEROXIDES

CATALYSTS FOR POLYMERIZATIONS
DRYING ACCELERATORS · OXIDATION AGENTS · BLEACHING AGENTS

LUCIDOL*
(BENZOYL PEROXIDE)

LUPERCO*
(PEROXIDE COMPOUNDS)

ALPEROX* C
(TECHNICAL LAUROYL PEROXIDE)

LUPEROX*
(PEROXIDE PASTES)

Special Organic Peroxides

* REGISTERED TRADEMARK

LUCIDOL CORPORATION
BUFFALO (5) N. Y.

Friction Sawing with Tannewitz HIGH SPEED BAND SAWS

"To date, we have not found any plastic it will not cut as fast as hand feeding can be done, or faster . . . "

. . . So writes Arthur A. Schwartz, chief tool research engineer of the Bell Aircraft Corporation.

The dispatch with which these machines are cutting plastics of all types as well as metal, formed or flat, 1-inch armor plate and a host of other materials, is so spectacular to some that they refuse to believe their own eyes. By all means get acquainted with them. Write for your free copy of "FRICTION SAWING" — by Arthur A. Schwartz.

Write for Your Copy

THE TANNEWITZ WORKS
GRAND RAPIDS 4, MICH.

MOLDING
in all commercial plastics
...IS OUR BUSINESS!

There's no application too imaginative, no technical problem too tough for our molding service to handle—and come up with successful moldings. We work in thermoplastics, thermosetting plastics and cold-molded materials, by injection, transfer & compression methods. We advise you from more than two decades of successful experience in design and production.

PLASTIC MOLDING
CORPORATION
SANDY HOOK, CONN.

NUMBERALL

NUMBERING and LETTERING PRESS

Write for Bulletin MP 204

An ideal machine for hot stamping letters and figures on plastic nameplates, and for other small parts, with the use of colored roll leaf. Furnished with an electric heating element, and rheostat for regulating heat. All figures and entire alphabet are on one dial.
We also make numbering machines . . . automatic and non-automatic . . . for stamping, either hot or cold, numbers and letters into various materials.

NUMBERALL STAMP & TOOL CO.
HUGUENOT PARK STATEN ISLAND 12, N. Y.

MOLDS

INJECTION

Submit your problems to our experienced engineering staff, equipped to handle your most intricate mold problems.

We design and build automatic molds for many leading molders. Why not let us solve your problems?

Our molds are tested before shipping, on our new 16 oz. Lester injection molding machine. 1911 • 1945

STANDARD TOOL CO.
75 WATER STREET
LEOMINSTER, MASS.

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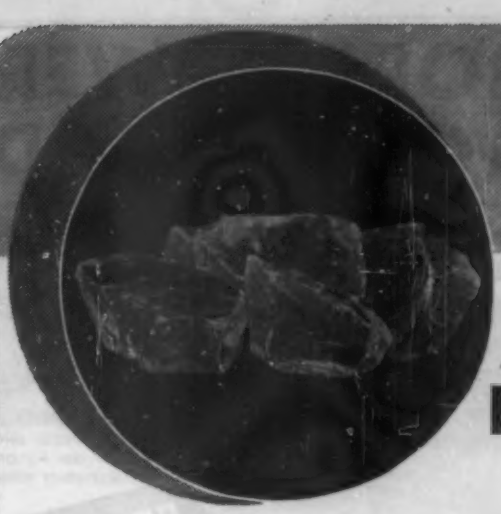

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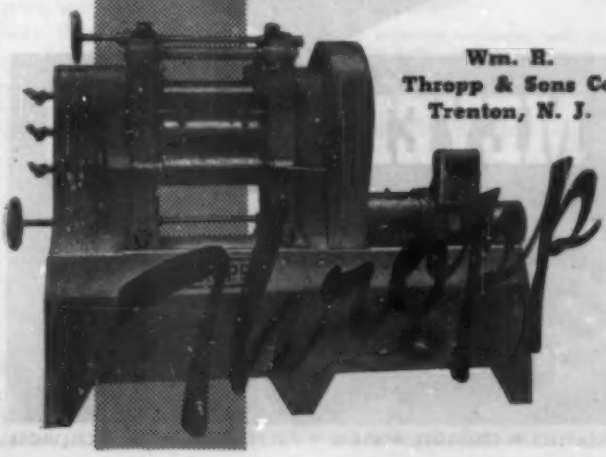

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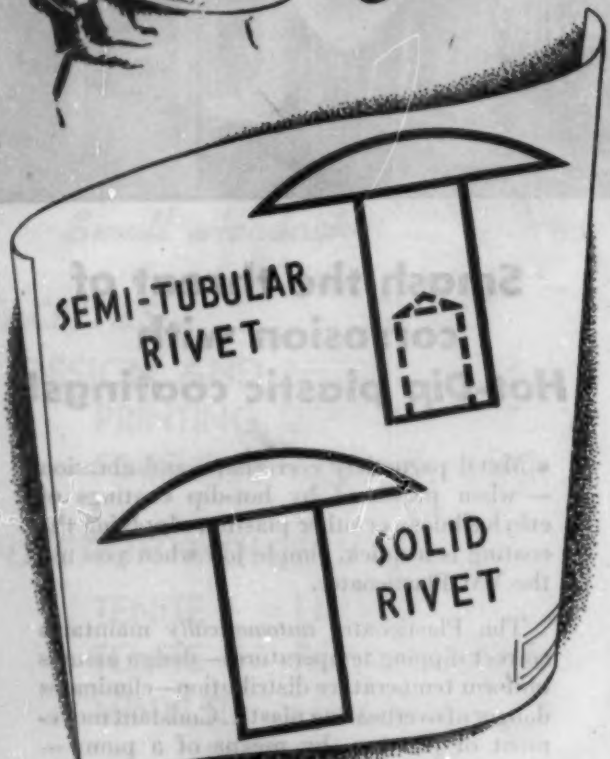

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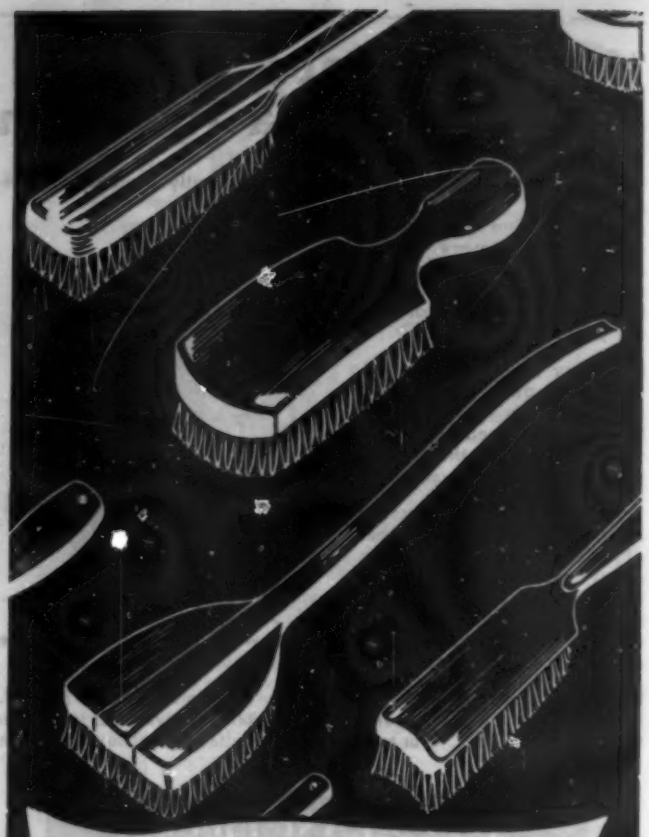

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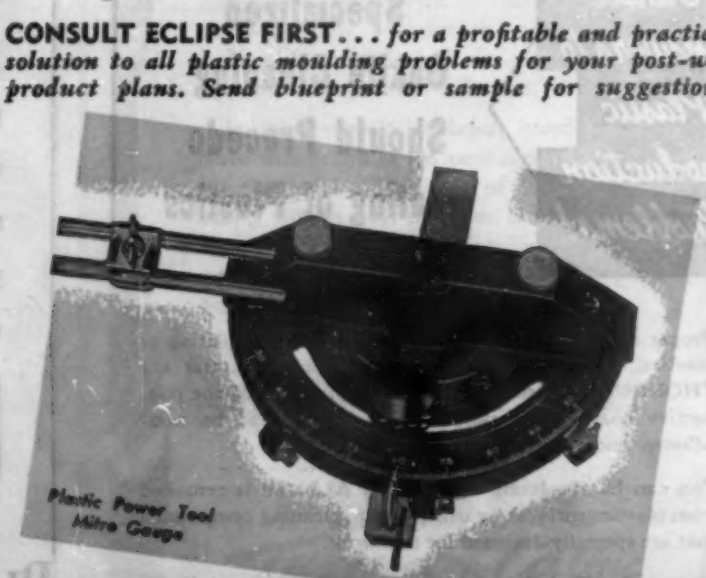

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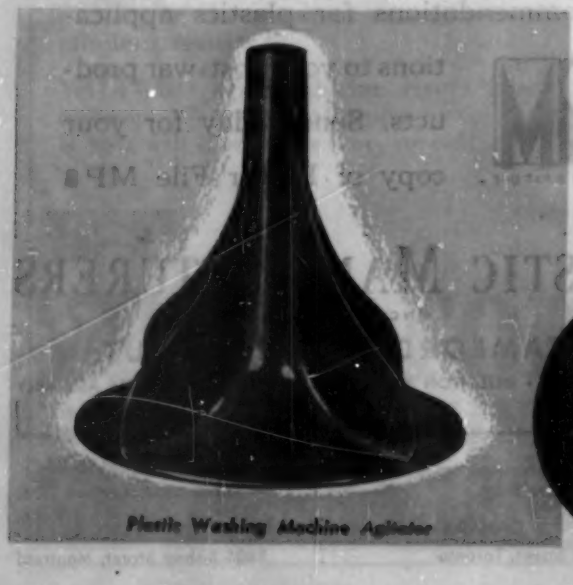

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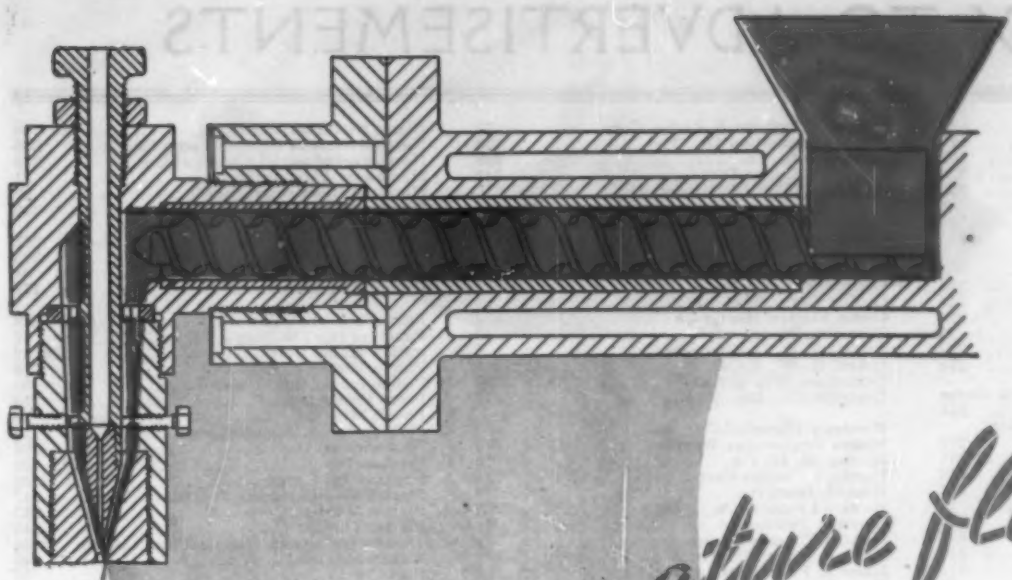

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